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National Institutes of Health
1973
annual report

NIH

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U.S. National Institutes of Health

1973 annual report

July 1, 1972 - June 30, 1973

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PREFACE

A component of the Department of Health, Education, and Welfare, the National Institutes of Health is the principal agency of the Public Health Service responsible for biomedical research and communication of biomedical knowledge.

To permit the full dissemination of information on its responsibilities and accomplishments this Annual Report for Fiscal Year 1973 is published. Appropriate tables showing appropriations, grants and other extramural awards, as well as personnel levels have been included.

It is hoped that this publication will provide a ready reference source for those interested in and concerned with the activities of NIH.

Robert S Stone, MD.

Robert S. Stone, M.D.
Director

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NATIONAL INSTITUTES OF HEALTH

Officers

as of

June 30, 1973

Robert S. Stone, M.D.	Director
John F. Sherman, Ph.D.	Deputy Director
Robert W. Berliner, M.D.	Deputy Director for Science
Thomas E. Malone, Ph.D.	Associate Director for Extramural Research and Training
Robert W. Berliner, M.D.	Associate Director for Intramural Research
Leon Jacobs, Ph.D.	Associate Director for Collaborative Research
Thomas J. Kennedy, Jr., M.D.	Associate Director for Program Planning and Evaluation
Thomas C. Chalmers, M.D.	Associate Director for Clinical Care
Leon M. Schwartz	Associate Director for Administration
Storm Whaley	Associate Director for Communications
Irving Goldberg	Director of Information
Frank J. Rauscher, Jr., Ph.D.	Director, National Cancer Institute
Carl Kupfer, M.D.	Director, National Eye Institute
Theodore Cooper, M.D.	Director, National Heart and Lung Institute
Dorland J. Davis, M.D.	Director, National Institute of Allergy and Infectious Diseases
G. Donald Whedon, M.D.	National Institute of Arthritis, Metabolism, and Digestive Diseases
Gerald D. LaVeck, M.D.	Director, National Institute of Child Health and Human Development
Seymour J. Kreshover, D.D.S.	Director, National Institute of Dental Research
David P. Rall, M.D.	Director, National Institute of Environmental Health Sciences
DeWitt Stetten, Jr., M.D.	Director, National Institute of General Medical Sciences
Donald B. Tower, Ph.D.	Acting Director, National Institute of Neurological Diseases and Stroke
Thomas C. Chalmers, M.D.	Director, Clinical Center
Arnold W. Pratt, M.D.	Director, Division of Computer Research and Technology
Stephen P. Hatchett, Ph.D.	Director, Division of Research Grants
Thomas G. Bowery, Ph.D.	Director, Division of Research Resources
Joe R. Held, D.V.M.	Director, Division of Research Services

Milo D. Leavitt, Jr., M.D.	Director, Fogarty International Center for Advanced Study in the Health Sciences
Kenneth M. Endicott, M.D.	Director, Bureau of Health Manpower Education
Peter L. Eichman, M.D.	Deputy Director
Charles H. Boettner, M.D.	Associate Director
Daniel F. Whiteside, D.D.S.	Associate Director
Eugene A. Confrey, Ph. D.	Associate Director for Policy Studies
Thomas D. Hatch	Director, Division of Allied Health Manpower
Harry W. Bruce, Jr., D.D.S.	Director, Division of Physician and Health Professions Education
Jessie M. Scott	Director, Division of Nursing
John C. Green, D.M.D.	Director, Division of Dental Health
William A. Lybrand, Ph.D.	Director, Division of Manpower Intelligence
Martin M. Cummings, M.D.	Director, National Library of Medicine
Melvin S. Day	Deputy Director
Charles F. Bridgman, Ph.D.	Associate Director for Audiovisual Telecommunications and Director of National Medical Audiovisual Center
Albert Feiner	Associate Director for Research and Development and Director of Lister Hill National Center for Biomedical Communications
Henry M. Kissman, Ph.D.	Associate Director for Specialized Information Services
Ernest M. Allen, Sc. D.	Associate Director for Extramural Programs
Joseph Leiter, Ph.D.	Associate Director for Library Operations
Davis B. McCarn	Acting Associate Director for Computer and Communications Systems

The National Institutes of Health

Year In Review

During a period of transition which saw a change of Directors, extensive organizational restructuring, and intensive planning to advance the research campaigns against cancer and heart disease, the National Institutes of Health in Fiscal Year 1973 continued to fulfill its mission—domestically and internationally.

Dr. Robert S. Stone was sworn in as NIH Director on May 29, 1973, replacing Dr. Robert Q. Marston. Dr. Stone, former Vice President for Health Sciences and Dean of the University of New Mexico's School of Medicine, immediately announced his intention of strengthening the research function inherent in NIH activity and tradition.

As part of the organizational restructuring, Caspar W. Weinberger was named Secretary of Health, Education, and Welfare, and Dr. Charles C. Edwards was appointed HEW Assistant Secretary for Health.

The National Cancer Institute and the National Heart and Lung Institute were elevated to Bureau status to expand, intensify, and coordinate research in an effort to bring about a solution to these diseases.

On the international scene, NCI, NHLI, and the National Institute of Environmental Health Sciences made several agreements with the Soviet Union to cooperate in research on cancer, heart disease, and environmental health.

Scientists and physicians from the People's Republic of China visited NIH on October 13 and 14, 1972. The visit, sponsored by the Fogarty International Center, included tours of the National Library of Medicine, and research laboratories in the Clinical Center.

During Fiscal 1973, the NCI completed development of the National Cancer Program Plan. It was projected for a 5-year period and condensed into a Strategic Plan and a Digest of Scientific Recommendations. Implementation of elements of the overall national program also was begun.

In July 1972 a National Hypertension Program was initiated to alert the public and professional communities about the most common of the heart and blood vessel diseases—high blood pressure—which affects an estimated 23 million people.

The goals of the program include making use of the recent development of a wide variety of effective blood-pressure-lowering drugs; establishing standards and conditions for treatment; educating professional health workers, and creating a broad program of public information.

Minority Activities

Raymond J. Jackson was named Equal Employment Opportunity Officer in May 1973 replacing Dr. Colvin L. Gibson, who was appointed assistant to the Director for Commissioned Officers, Office of Personnel Management. Mr. Jackson came to NIH from the Federal Aviation Administration where he was a civil rights specialist.

The Upward Mobility College at NIH, operated in conjunction with Federal City College's Division of Community Education, celebrated its first anniversary. UMC enrollment rose to more than 750 students during the year with an average quarterly enrollment of about 400 students.

Under the Minority Schools Biomedical Support program, 38 educational institutions were awarded $2 million by the Division of Research Resources to involve minority school scientists in biomedical research and to offer training to minority students.

Special Faculty Fellowships were awarded by the National Institute of General Medical Sciences through the Minority Access to Research Careers (MARC) program. Health research scientists and teachers at 12 colleges and universities founded for Black Americans will receive the fellowships to advance their careers.

The National Institute of Environmental Health Sciences and St. Augustine's College, Raleigh, N.C., agreed to undertake the Access/Cooperative Work-Study Agreement. A similar program has also been started at North Carolina A&T University in Greensboro. Under the President's Stay-in-School Program, disadvantaged young people are provided with work plus finances to continue their education.

Honors and Awards

Dr. Christian B. Anfinsen, chief of the Laboratory of Chemical

Biology, National Institute of Arthritis, Metabolism, and Digestive Diseases, and four NIH grantees were named winners of Nobel Prizes.

Dr. Anfinsen was given the prize for his pioneering research into the enzyme ribonuclease. His work is of importance in understanding the mechanisms of metabolic disorders which result from abnormal affects on protein structure and synthesis.

Sharing the prize for Chemistry with Dr. Anfinsen were Drs. William H. Stein and Stanford Moore, both of Rockefeller University. They have received grant support from NIGMS for the past 12 years. The Nobel Prize in Physiology or Medicine was won by Dr. Gerald M. Edelman of Rockefeller University—a grantee of NIAMDD and the National Institute of Allergy and Infectious Diseases—and Dr. Rodney R. Porter of the University of Oxford in England, an NIAID grantee in 1960 while with the University of London. This brings the total of Nobel Laureates employed or supported by NIH to 54.

The Rockefeller Public Service Award was given to Dr. Wallace P. Rowe, NIAID, in recognition as an outstanding Federal civil servant. During his 20 years as a Public Health Service Commissioned Officer, he made numerous scientific contributions in the areas of acute respiratory, latent, and tumor viruses.

Twelve National Cancer Institute researchers and grantees were among the scientists who were named as winners of the 1972 Albert Lasker Medical Research Awards. Dr. C. Gordon Zubrod, director of NCI's Division of Cancer Treatment, was given a Special Award in Clinical Cancer Chemotherapy "for his administrative leadership . . . and creating an effective national cancer chemotherapy program." The NCI recipients were: Dr. John L. Zeigler, director, Uganda Cancer Institute in Kampala, Africa; Dr. Paul Carbone, associate scientific director for Medical Oncology; and Dr. Vincent T. DeVita, Jr., chief, Medicine Branch.

Dr. Thomas J. King, director of NCI's Division of Cancer Grants, shared the $24,000 French Academy of Sciences Award with Dr. Robert W. Briggs, an NIGMS grantee, for their work in cell nucleus transplantation.

The 1973 Career Service Award for Sustained Excellence was presented to Dr. John F. Sherman, NIH Deputy Director, by the National Civil Service League for his "outstanding achievements in the development and effective administration of programs of biomedical research and education at NIH."

Dr. Robert S. Gordon, Jr., NIAMDD clinical director, was awarded the 1972 Stouffer Prize for research on free fatty acids conducted during the mid and late 1950's when he was with the National Heart Institute.

The Mortimer Spiegelman Gold Medal for 1973 was awarded to NHLI's Dr. Manning Feinleib by the American Public Health Association for "his continuing application of advanced statistical methods to a broad spectrum of problems in the fields of cancer, cardiovascular, and genetic research. . . ."

Dr. Carl Kupfer, National Eye Institute Director, received the Secretary of Health, Education, and Welfare's Special Citation in recognition of "outstanding performance in the development of the National Eye Institute."

Secretary Weinberger presided at the Annual DHEW Honor Awards Ceremony in the Departmental Auditorium at which three NIH scientist-administrators were honored. Elizabeth A. Chase, special assistant for Legislation, Bureau of Health Manpower Education, was given the Distinguished Service Award. Distinguished Service Medals were presented to Jessie M. Scott, Director, Division of Nursing, and to Dr. Robert L. Bowman, chief, Laboratory of Technical Development, NHLI.

Appointments

Dr. Thomas E. Malone was selected as NIH associate director for Extramural Programs replacing Dr. Ronald W. Lamont-Havers, who was named NIAMDD deputy director. Dr. Malone was formerly associate director for Extramural Programs, National Institute of Dental Research.

In another appointment, Dr. Joe R. Held was named Director of the Division of Research Services succeeding Dr. Roger D. Estep, who resigned to become Vice-President for Development and University Relations at Howard University. Dr. Held previously was chief of the Veterinary Resources Branch, DRS.

Facilities And Organization

A reorganization of health activities was announced during May 1973 by Secretary Weinberger. Under the reorganization, the Bureau of Health Manpower Education was transferred from NIH to the newly-created Health Resources Administration. BHME was renamed the Bureau of Health Resources Development, effective July 1, 1973.

Several components celebrated anniversaries in 1973. The National Heart and Lung Institute and the National Institute of Dental Research marked their 25th year of service, the Clinical Center reached the 20-year plateau, and the National Institute of General Medical Sciences posted its 10th year.

To provide for the expanding scope and staff of NIH, office space was leased in the Landow Building in Bethesda. Approximately 600 employees of the National Institute of Child Health and Human Development; NCI; NIAMDD; NHLI; the Office of Personnel Management and the Office of Administrative Services, Office of the Director, moved into the 92,000 square feet of space during late 1972.

Research Advances

Dr. Elizabeth F. Neufeld, NIAMDD, and a research team pinpointed the biochemical defect in Hurler's syndrome, an inherited metabolic disorder marked by skeletal deformities ("gargoylism"), mental retardation, and early death. Implications of the findings are far-reaching and include the possibility that early correction might prevent, or at least ameliorate, the disorder's bizarre clinical manifestations.

In the National Cancer Institute's *End Results in Cancer*, 3-year survival rates reported from 1965-69 showed an increase over rates diagnosed from 1940-49 for cancer types of bladder, brain, chronic lymphocytic leukemia, larynx, melanoma of the skin, multiple myeloma, prostate, and thyroid. Other cancers that had increases in survival were childhood leukemia, Hodgkin's disease, and breast cancer. However, little or no improvement has occurred in life expectancy for patients with lung cancer or cancer of the pancreas.

For the first time, scientists at NHLI, the Mayo Clinic, and the Ciba Pharmaceutical Company determined the chemical structure and synthesized the biologically active portion of the human parathyroid gland. This makes possible synthesis of the hormone's active component for experimental studies of its role in calcium metabolism and metabolic bone disease, for the development of diagnostic assay procedures for its measurement in human blood, and for its clinical investigation as a potential use as a therapeutic agent.

NCI's Dr. Mearl F. Stanton and associates developed a new technique to produce lung cancer in rats. Using the products of cigarette smoke, a beeswax-cigarette condensate was injected into the rodents' lungs. The method, for the first time, produced the lung cancer that occurs most commonly in humans. Dr. Stanton plans to apply the technique to test various fractions of cigarette smoke condensate in an attempt to pinpoint specific substances which may be responsible for lung cancer.

An NIAID-supported scientist, Dr. Thomas C. Merigan, and a British research team reported that interferon—a naturally occurring antiviral substance produced in the body in response to a viral infection—is an effective preventive against the common cold. Dr. Merigan, in England on an NIAID fellowship from Stanford, stressed that the study holds promise for patients at serious risk from viral respiratory infections such as influenza, but further investigation needs to be done before it can be practically applied.

In April 1973 the first nuclear-powered pacemaker developed completely in the United States was implanted in a patient during an operation at the Clinical Center by NHLI surgeons. Developed under Atomic Energy Commission contracts, the device is designed to have a useful life of about 10 years or longer. They are presently being utilized in clinical trials for evaluation and study before mass production is started.

National Cancer Institute

The National Cancer Program

In Fiscal Year 1973 the National Cancer Institute operated at a budget level of $432 million, an increase of $55 million over the previous year. This increased funding, the highest in NCI history, reflected the continuing national commitment to the conquest of cancer.

Scientific and administrative leadership of the NCI worked throughout FY 1973 on development of the National Cancer Program Plan, authorized by the National Cancer Act of 1971. The plan, based on 764 detailed project areas recommended in 1971 by more than 250 Federal and non-Federal scientists, was reviewed late in 1972 by the Institute of Medicine, National Academy of Sciences.

In Fiscal 1973 the National Cancer Program Plan was projected for a 5-year period and condensed into a Strategic Plan and a Digest of Scientific Recommendations.

Another major element of the National Cancer Program is development of Comprehensive Cancer Centers to bring research results as rapidly as possible to a maximum number of people. On June 20, 1973 Dr. Frank J. Rauscher, Jr., Director of the National Cancer Program, reported the names of the first eight new Comprehensive Cancer Centers. They are: The Children's Cancer Research Foundation, Boston; The Johns Hospkins Medical Institutions, Baltimore; Duke University Medical Center, Durham; University of Alabama School of Medicine, Birmingham; University of Wisconsin Medical Center, Madison; Fred Hutchinson Cancer Research Center affiliated with the University of Washington, Seattle; University of Southern California (with the Los Angeles County Department of Hospitals), Los Angeles; and the University of Miami School of Medicine, Miami.

NCI and the National Cancer Advisory Board had previously recognized three NCI-supported institutions as Comprehensive Cancer Centers: the M. D. Anderson Hospital and Tumor Institute, Houston; Memorial Sloan-Kettering Cancer Center, N.Y.C.; and Roswell Park Memorial Institute, Buffalo.

To increase the Nation's facilities for cancer research, NCI allocated $34.2 million for construction and alteration of facilities in Fiscal 1973. Nine of the Comprehensive Cancer Centers received construction grant awards.

Management sharing is an important feature of the new National Cancer Program. With the approval of the National Cancer Advisory Board, other institutions have been delegated certain management responsibilities for major components of three national research programs funded by grants. Specifically, for cancers of the bladder, large bowel, and prostate, headquarters are located at St. Vincent Hospital, Worcester, Mass.; the University of Texas M. D. Anderson Hospital and Tumor Institute; and Roswell Park Memorial Institute, respectively.

Cancer Control

A Cancer Control Program authorized by the National Cancer Act, was initiated with assistance from an ad hoc advisory committee in November 1972.

By June 1973, the NCI Cancer Control Program had awarded a total of $5.2 million in contracts. These included:

- Demonstrations of the latest treatments for three types of cancer to be conducted by seven primary hospitals through a network of 120 contributing community hospitals.
- Designation of the first 11 of 20 centers to make the latest methods of breast cancer screening more widely available throughout the country. This is a joint program of NCI and the American Cancer Society.
- Surveys of Federal, State, local and voluntary cancer control programs throughout the U.S.
- Setting certification requirements for cancer activities at approximately 400 hospitals per year.
- Providing consultation services to hospitals for development of cancer education programs for health professionals.
- Operation and expansion of a dial access telephone system which provides information on cancer diagnosis and treatment.
- An educational program for cancer rehabilitation professionals and a model system of rehabilitation services for cancer patients to be developed at the University of Alabama Medical Center.

Viruses and Cancer

Strong evidence relating viruses to human cancer was reported by NCI and NCI-supported scientists in Fiscal 1973. Using sophisticated biochemical and immunological techniques, they determined that an enzyme in human acute leukemia cells cannot be distinguished from a similar enzyme carried by primate cancer viruses of the RNA type. This finding suggests that the enzyme in the human leukemic cells may be of viral origin, although it does not indicate that viruses cause the disease.

Another team of NCI-supported scientists reported detecting the hereditary information of animal leukemia viruses in 95 percent of the human leukemia cells they studied. NCI scientists reported also that a postulated human cancer virus named RD-114, which had been isolated from cells of human muscle cancer, was a cat virus.

For many years, investigators have studied the suspected role of certain human herpes viruses (DNA viruses), known as type 1 and type 2, in various human cancers. Most of the evidence to implicate the type 2 herpes virus was statistical or based on evidence of antibodies found in patients with cancer of the uterine cervix. Less information has been available on the type 1 virus.

NCI-supported scientists from the University of Chicago and Emory University, Atlanta, reported that cells from human cancers of the uterine cervix contained fragments of hereditary information from the type 2 virus in each cancer cell. These segments were found chemically linked to the hereditary information of the cells.

In April 1973, scientists working at the NCI Frederick Cancer Research Center, Frederick, Md., reported to the National Academy of Sciences that the fluid portion of the blood of persons with certain types of cancer contains antibodies specific for herpes viruses type 1 and type 2. Their findings suggest that herpes viruses may be associated with cancers of the lip, mouth, oropharynx, nasopharynx, kidney, bladder, prostate, uterine cervix and vulva.

The NCI's Virus Cancer Program plans to study larger numbers of cancer patients to determine the exact relationship of herpes viruses to specific human cancers.

As part of the May 1972 US-USSR agreement, U.S. and Soviet scientists are cooperating in research on viruses which can cause leukemias and solid tumors in animals. Scientists have begun an exchange of materials and test systems for immunological identification of viruses, virus components or virus-induced proteins.

Cancer Treatment

Surgery, radiation and drug treatment—singly, but more often in combinations—are the principal focus of cancer treatment research.

Surgery, the most often used therapy in the U.S., has been the mainstay of effective treatment for breast cancer. In August 1972, the Institute announced support for a study at the University of Pittsburgh to evaluate methods used to treat early breast cancer—surgical procedures as well as radiation and drug therapy.

Also during the year, two teams of scientists independently reported promising new results in treating Ewing's sarcoma, a usually fatal form of bone cancer afflicting children and young adults. A 7-year investigation at NCI and St. Jude Children's Research Hospital, Memphis, indicated that intensive irradiation of the primary bone tumor can be combined with drug therapy to prevent spread of cancer to other areas. Increasing numbers of patients so treated are now living without recurrence.

NCI scientists achieved further improvements in treating Hodgkin's disease, a form of cancer of the lymph system. Of every 100 patients treated at NCI with a 4-drug combination treatment program known as MOPP, 80 went into complete remission, or disappearance of all evidence of their disease. Sixty-five of the 100 patients can expect to remain alive, and 40 will be continuously free of disease, and apparently cured, after five years.

In April 1973 scientists of the NCI Medicine Branch reported that the use of combinations of drugs on patients with other types of advanced cancer of the lymph system resulted in remissions for prolonged periods. Eighty previously untreated patients with various types of advanced non-Hodgkin's lymphoma were given a 6-month course of drug treatment by NCI scientists, using one of three basic combination drug treatments. Thirty-six patients, or 45 percent, achieved complete remissions. Twenty-two of the 36 had remissions lasting one to seven years. This is the first major indication that patients with non-Hodgkin's lymphomas of all types can achieve extended disease-free survival periods without continued treatment.

In December 1972 the Institute announced an agreement with Bristol Laboratories, the first of its kind, for the marketing of BCNU, a drug developed and tested in NCI research programs. It has been shown to be useful in treating certain cancers of the brain, lymph system, bone marrow, and skin, and to a lesser extent in cancers of the breast, colon, and lung. Under the agreement, Bristol Laboratories will manufacture BCNU and market it at a reasonable cost. If research results continue to indicate the usefulness of two related drugs, CCNU and methyl CCNU, they will be made available.

Under the US-USSR Cooperative Agreement, a series of joint conferences were held in Moscow in Fiscal 1973. Meetings concerned chemotherapy, cellular genetics, immunotherapy and virus studies.

The agreements and plans set forth at the Moscow conferences defined immediate and long-range objectives. In cancer treatment, attention is being given to selection, screening, assessment and evaluation of drugs used to treat widespread human cancers. Plans for joint publication of results in drug development in two countries are under evaluation.

Detection and Diagnosis

In March 1973 X-ray mammography was reported to be of value in a breast cancer screening program conducted by the Health Insurance Plan of Greater New York, under contract with NCI. Investigators found that women examined annually by palpation and X-ray mammography had a one-third lower death rate from breast cancer over a 5-year period, compared to women receiving routine medical care. One-third (44 out of 132) of the breast cancers detected in the screening program were found by X-ray mammography before the tumors were large enough to be detected physically. Only one of these 44 women died of breast cancer during the 5-year period, indicating that early detection led to more effective treatment.

To make breast cancer screening more widely available throughout the U.S., NCI and the American Cancer Society launched a joint program of breast cancer detection clinics in early 1973. The $8 million program, with about two-thirds of the funds coming from NCI, established centers where women receive free examinations by palpation, mammography and thermography, a technique which measures skin temperature. The demonstration program will acquaint a great number of health professionals with better breast cancer screening methods.

The centers, which have a balanced geographic distribution, will each screen at least 5,000 women annually. Eleven centers were designated by June 1973: College of Medicine and Dentistry of New Jersey, Newark; Emory University School of Medicine and Georgia Baptist Hospital, Atlanta; Kansas University Medical Center; Medical College of Wisconsin, Milwaukee; Mountain States Tumor Institute, Boise; St. Vincent's Medical Center, Jacksonville; Stella and Charles Guttman Breast Diagnostic Institute, N.Y.C.; University of Cincinnati; University of Louisville School of Medicine; University of Oklahoma, Oklahoma City; and Virginia Mason Hospital, Seattle. An additional nine centers will be named by the end of 1973.

Cancer detection and diagnosis may be aided by measurement of cancer-related biochemicals in the blood or urine. In June 1973, Drs. Thomas A. Waldmann and K. Robert McIntire, NCI scientists, reported that a highly sensitive test they developed for one such chemical, alpha-fetoprotein (AFP), identified abnormally large amounts of AFP in the blood of patients with cancer of the liver or testis. The scientists used AFP and another chemical, human chorionic gonadotropin (HCG), to monitor the effectiveness of treatment for liver or testicular cancer. Blood levels of one or both of the chemicals dropped rapidly after surgery but did not reach normally low levels if some cancer cells remained in the patient. Levels rose again if the cancer resumed its spread, giving an early indication of the need for further treatment.

Another cancer "marker," carcinoembryonic antigen (CEA), has been found in high levels in patients with a number of cancers, including cancers of the gastrointestinal tract, pancreas, lung, breast and testis. Several NCI-supported studies found, however, that CEA levels are high in some patients with other diseases, particularly cirrhosis of the liver, pancreatitis, and other gastrointestinal diseases. Another problem is that CEA may remain at a normal level in some patients with known early cancer. CEA may nonetheless be useful in following the course of treatment, perhaps in combination with AFP or other "markers."

Chemicals and Cancer

In 1973, NCI scientists developed a new method for rapid testing of chemicals for potential cancer-causing activity. Early tests suggest it may offer an efficient and economical procedure for screening thousands of environmental substances. With the new procedure, test chemicals are injected into pregnant hamsters; the embryos thus exposed are removed and their cells grown in the laboratory. Evidence of cancerous transformation can be detected in as little as two weeks, and is confirmed by the cell's ability to produce cancer when injected into healthy hamsters. Since the suspected substances are injected into living animals, the technique tests chemicals capable of causing cancer directly, as well as those that cause cancer only after activation by body metabolism.

NCI-supported scientists at Oak Ridge National Laboratory and the Eppley Institute for Research on Cancer, Omaha, reported evidence that nitrosamines, cancer-causing chemicals, may be formed in the stomach from nitrites and amines, substances found in some human foods and drugs. Their studies indicated that Vitamin C, also common in the human diet, may prevent the occurrence of the reaction and thus protect against the cancer-causing effect.

Further evidence that the hormone DES causes cancer was reported by physicians at the Massachusetts General Hospital. Ninetyone cases of vaginal and cervical cancer in young women were recorded during the first year of an NCI-supported registry of these previously rare types of cancer. Most of the cases could be linked to exposure during fetal life to DES or related drugs, prescribed for their mothers during pregnancy to prevent miscarriage.

An NCI investigator reported that he had produced lung cancer in rats by exposing them to products of cigarette smoke. He mixed the smoke condensate with warm beeswax and injected it into rats' lungs. The beeswax remained in place, allowing the smoke condensate to leak out gradually. This mimicked the continuous exposure of heavy smokers to cigarette smoke. The product of only five cigarettes was sufficient to cause lung cancer in the rats.

The same NCI scientist reported that the cancer-causing activity of asbestos is due to its fibrous structure rather than its chemical composition. Experiments on rats showed that very fine fibers of asbestos, glass or sapphire caused many cases of mesothelioma, a cancer of the membranes lining the lungs and abdomen. Coarse fibers or powdered materials of the same composition only rarely caused cancer.

The first three volumes in the series, *Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man,* were published in 1973 by the International Agency for Research on Cancer, with NCI support. Evidence for cancer-causing activity of about 50 chemicals are summarized in a condensed and uniform style. Work on additional volumes is underway.

A major animal facility for long-term screening of chemicals that may cause cancer went into operation this fiscal year at the Frederick Cancer Research Center. Approximately 25 chemicals will be screened initially with 35 additional chemicals to be designated. Including this long-term animal study, it was estimated that 450 chemicals were under study in Fiscal 1973 by NCI and NCI-supported scientists. Among these were environmental agents such as pesticides, agricultural agents, food additives, air and water pollutants and household products.

Immunology and Cancer

In October 1972 an international conference was held at NCI to review research with BCG (bacillus Calmette-Guérin), a tuberculosis vaccine being evaluated as an anti-cancer agent. BCG is believed to act by stimulating the body's immune system to attack cancer cells. Dr. Herbert J. Rapp and fellow NCI scientists reported on research with guinea pigs in which injections of BCG reversed the growth of established tumors if injected into the cancer site at an early stage.

Several other scientists there also reported preliminary findings suggesting that BCG might have some value in treating certain cancers. A possible role for BCG in treatment of childhood leukemia, common skin cancers, and malignant melanoma, an uncommon but often fatal cancer of the skin, had been suggested in earlier studies by Dr. George Mathé, Paris, France; Dr. Donald L. Morton while at NCI; Dr. William W. Shingleton, Duke University; and Dr. Edmund Klein, Roswell Park Memorial Institute.

In an NCI-supported study, patients with advanced malignant melanoma are being treated with BCG at the University of Washington, Seattle. In addition, the patients receive blood serum containing a factor that may counteract a complex in the patients' blood that blocks immune reactions with cancer cells. The findings thus far are preliminary.

In an NCI-supported study at the University of Minnesota, patients with advanced malignant melanoma, cancers of connective tissue such as bone, muscle and fatty cells, or neuroblastoma (a cancer of nerve cells) are being treated with BCG in combination with a preparation of their own cancer cells. The cancer cells are treated with the enzyme, neuraminidase, which increases the cells' immunologic reactivity by altering their surfaces. It is too soon, however, to anticipate results.

In early 1973 NCI established an International Tumor Immunotherapy Registry to serve as a world-wide center for information on clinical trials of cancer treatment by immunologic methods. The registry collects and distributes reports on the progress of current studies. The exchange of information is intended to prevent duplication of unsuccessful treatments and encourage cooperation in studies of promising approaches.

Using an ingenious new technique reported in March 1973, antigens, substances which initiate the body's immune response, can now be visualized on cancer cell surfaces with the aid of the electron microscope and fluorescent antibodies. Dr. Tadao Aoki, now at NCI after conducting NCI-supported research at the Sloan-Kettering Institute for Cancer Research, reported that he and associates had visualized several types of antigens on the surfaces of both normal and cancerous animal cells. The antigens appeared to be specific for a number of viruses that cause cancer in animals. Applications of immunoelectron microscopy to human cells may help define a possible role for viruses in human cancer, or may lead to isolation of surface antigens for use in diagnosis and treatment.

Demography

In September 1972 at the 7th National Cancer Conference, NCI's Biometry Branch issued its fourth "End Results in Cancer" report on trends in survival of white patients diagnosed with cancer from 1940 through 1969 in more than 100 U. S. hospitals. (Similar information on Black Americans is being collected and analyzed for future publications.)

The report showed improvements in the outlook for survival of patients with cancers of the bladder, brain, larynx, prostate, thyroid, and breast, chronic lymphocytic leukemia, melanoma of the skin, multiple myeloma, childhood leukemia, and Hodgkin's disease. There was little or no improvement in life expectancy for patients with lung cancer or cancer of the pancreas, two of the leading cancer killers in the U.S. Early detection, while the cancer is localized or limited to the organ of origin, offers the best opportunity for control in most forms of cancer.

Also reported at the conference were NCI studies of Japanese migrants to Hawaii, providing new evidence that cancer of the stomach and of the bowel are related to diet. The evidence suggests that diet in youth determines susceptibility to stomach cancer, which is common in Japan but rare in the U.S. Bowel cancer, rare in Japan but common in the U.S., may be related to a low bulk diet rich in meat, especially beef.

National Eye Institute

More than 9.6 million people in the United States suffer from impaired vision, at least 340,000 of whom are legally blind. In addition, an estimated 32,000 become blind each year. To reverse these statistics, the National Eye Institute is conducting and supporting research to improve the prevention, diagnosis, and treatment of visual disorders. Four major disease groups under investigation are: retinal disorders, glaucoma, cataract, and corneal disease.

Retinal Disease

More than one-third of all blindness in the U.S. is caused by disorders of the retina, the light-sensitive tissue which lines the back of the eye. Unfortunately, for most retinal diseases there is neither a cure nor means of prevention. For this reason, the Institute is fostering research aimed at a better understanding of retinal function in health and disease.

A scientist working in the NEI's Laboratory of Vision Research has demonstrated the damaging effect of light on the retina. In studies of normal monkey retinas, he found repeated exposure to light flashes caused substantial damage to the photoreceptor cells. Observed cellular changes were similar to those occurring in the normal human macula, the area of the retina responsible for fine or reading vision. The study indicates that a large number of human photoreceptor cells may be receiving damaging light exposure and disappearing, as did those in the monkey retina, as a part of the physiological aging process. Although this is of no clinical significance in a normal eye, it may play a contributory role in certain retinal diseases.

The NEI-supported Diabetic Retinopathy Study, now in its second year, is continuing to treat patients with this retinal blood vessel disorder. The study is designed to determine whether photocoagulation—therapy employing an intense beam of light—is useful for preserving vision in patients with this disease. Fifteen clinical centers throughout the Nation are participating in the study, and over 300 patients have already been treated. Although photocoagulation is becoming increasingly popular for treatment of diabetic retinopathy, the study is the first one designed to assess the effectiveness of the treatment in a large number of patients.

Glaucoma

A leading cause of blindness, glaucoma is characterized by an elevation in pressure within the eye followed by damage to the optic nerve and subsequent loss of vision. Nearly 800,000 Americans suffer from glaucoma, and more than 34,000 of these are blind because of it.

One of the most puzzling aspects of glaucoma is how the elevated pressure within the eye causes damage to the optic nerve. In an attempt to understand this, NEI-supported researchers at the University of Chicago have developed a technique which allows a better understanding of the relationship of changes in the circulation of blood to various levels of intraocular pressure. They combined the use of fluorescein angiography, a technique which employs a flourescent dye to visualize the small vessels around the optic nerve, with a method of inducing a rise in intraocular pressure. The detailed knowledge of the relationship between intraocular pressure and the flow of blood through ocular vessels gained in this study may help make possible the treatment of glaucoma based on changes in the eye's circulatory system before there is damage to the optic nerve.

At the Washington University School of Medicine, NEI grantees are studying the use of the new soft contact lens as a reservoir for medication. The team investigated the effects of the lens soaked in a glaucoma drug (pilocarpine) and found intraocular pressure was reduced in patients during the 23 hours these lenses were worn. The potential advantages to glaucoma patients of pilocarpine-soaked lenses include daily control with a single treatment, incorporation of any needed refractive correction into the lens, and a greater effect on reducing intraocular pressure.

Cataract

Although cataract surgery is one of the most successful operations performed, this condition remains one of the leading causes of blindness. In fact, more than 40,000 people in the nation are blind because of cataract. To combat this problem, NEI is fostering research aimed at prevention and non-surgical treatment of cataract.

A researcher in the Institute's Laboratory of Vision Research has been studying the formation of the sugar cataract, such as those which occur in diabetes and galactosemia, a rare hereditary disorder. He has found that this type of cataract is triggered by an enzyme, aldose reductase, which is normally inactive in the lens. Research has identified an inhibitor of the enzyme, and this type of cataract can now successfully be prevented in the test tube and delayed in living animals.

The development has stimulated further research into the formation of other forms of cataract, including the type commonly associated with aging. A new hypothesis of senile cataract formation has led to the induction and subsequent reversal of a cataract in a test tube culture which is believed to parallel the condition which occurs in elderly patients.

Corneal Disease

Corneal diseases, though not a major cause of blindness in this country, are the leading cause of blindness worldwide and are among the most painful of eye disorders. Diseases of the cornea, the transparent tissue which protects the front of the eye, may scar the tissue causing severe visual disability.

One of the most difficult corneal diseases to treat is that caused by the herpes simplex virus. Although the virus infection may be temporarily relieved, it often recurs. An NEI grantee at the University of Florida, who first used the now-standard antiviral drug—idoxuridine (IDU)—to cure herpes simplex keratitis, has found a new antiviral drug superior for healing corneal ulcers caused by the virus. In studies conducted at the University and at Moorsfields Eye Hospital in London, it was found that the drug, trifluorothymidine (F_3T), not only healed more patients than IDU but also an average of two days sooner.

To define specific areas where increased research emphasis is needed in corneal disease, the NEI convened a Corneal Task Force. The 24 participants identified 12 areas for research emphasis: immunopathologic mechanisms, herpes simplex, scar of corneal opacification, edema, drugs and delivery, tear film, keratoplasty and keratoprothesis, physical factors involved in corneal disease, nonspecific inflammation, epidemiology, interrelationship of inflammation with tissue destruction, and tumor virology and immunology. Their recommendations are providing a guide for the Institute's corneal research effort.

National Heart and Lung Institute

During Fiscal 1973, there was a substantial expansion of the Institute's responsibilities in heart and blood vessel diseases, lung diseases, blood diseases and blood resources. The National Heart, Blood Vessel, Lung and Blood Act of 1972, enlarged NHLI authority and called for expanded, intensified, and coordinated programs in accordance with a comprehensive 5-year plan, subsequently developed within 180 days by the Institute and its advisory bodies, and transmitted by DHEW to Congress in July 1973.

The Secretary of HEW also approved a reorganization of the Institute and elevated it to Bureau status within NIH. Under the Office of the Director, six division-level components were established: the Division of Heart and Vascular Diseases, Division of Lung Diseases, Division of Blood Diseases and Resources, Division of Technological Development, Division of Intramural Research, and Division of Extramural Affairs.

Division of Heart and Blood Vessel Diseases

Within this group of diseases, the most prevalent and serious health problem is arteriosclerosis, a degenerative disease affecting arteries throughout the body. Coronary heart disease afflicts nearly 4 million American adults. It causes an estimated 1.25 million heart attacks a year and about 600,000 deaths. Arteriosclerosis of the blood vessels of the brain is the major cause of strokes, which cause more than 200,000 deaths a year and leave nearly a million persons partially or completely disabled. These and other consequences of arteriosclerosis are responsible for an estimated 85 percent of all death and disability from cardiovascular disorders.

Early in the year, the Institute funded additional Specialized Centers of Research on arteriosclerosis, bringing to 15 the number of SCORs attacking high-priority problems in this disease area. Each individual center deals with only a limited number of these problems. But their research programs are complementary and their activities coordinated by NHLI so that they cover most of the promising lines of inquiry.

Epidemiological studies have established that susceptibility to arteriosclerosis and coronary heart disease is increased by certain risk factors. In August 1972, the Institute awarded contracts to establish eight clinical centers and a coordinating center for planning and conducting a Multiple Risk Factor Intervention Trial for the prevention of coronary heart disease. The trial is designed to determine whether and to what extent reduction of elevated blood lipids, high blood pressure, and cigarette smoking will reduce the incidence of heart attacks and mortality from coronary heart disease among high-risk males aged 40-59. An additional 12 centers are planned for the trial, which will entail a 6-year period of clinical management.

Prevention is also the goal of an intervention study directed against Type II hyperlipoproteinemia, a blood-lipid disorder characterized by excessive blood cholesterol. This disorder, believed to be common in the U.S. population, is often familial, with the familial form being dominant, and carrying a high risk of premature coronary heart disease.

Lipid Research Clinics, previously established by NHLI at 12 medical centers around the country, are conducting studies to determine the prevalance of Type II hyperlipoproteinemia in the U.S. population and are also making preparations for an intervention study. The elevated blood cholesterol levels of Type II can be reduced, and often normalized, by therapeutic diets supplemented, as necessary, with cholesterol-lowering drugs, especially cholestyramine. The trials will evaluate the effectiveness of these preventive measures in subjects with Type II who have not yet developed clinical signs of coronary heart disease.

Contracts also were awarded early in the year for studies to develop and evaluate improved methods for the prevention and control of cardiac arrhythmias, believed responsible for a high proportion of the more than 300,000 sudden or pre-hospital cardiac deaths that occur each year in the U.S. These studies investigated basic mechanisms governing the metabolic and electrical properties of the heart, derangements in these mechanisms that might underlie potentially lethal arrhythmias, and drugs for preventing or suppressing them, including agents that might be injected at onset of symptoms by the victim.

Other contracts supported research seeking means of protecting the heart against the destructive consequences of blood and oxygen deprivation in order to reduce the extent and severity of heart damage resulting from acute heart attacks. These studies complemented and extended research on this subject funded during the previous year.

During Fiscal 1973, there were a number of meetings and exchanges among Soviet and American experts on cardiovascular disease in accordance with the US-USSR Health Exchange Program. This 5-year agreement, signed during the President's May 1972 visit to Moscow, provides for scientific cooperation in attacking problems of mutual concern in the areas of cardiovascular disease, cancer, and environmental health. The cardiovascular problem areas are (1) pathogenesis of arteriosclerosis; (2) management of ischemic heart disease; (3) myocardial metabolism; (4) congenital heart disease; (5) sudden death; and (6) blood transfusions, blood components, and prevention of hepatitis.

Coronary artery bypass grafts, in which segments of saphenous vein are used to detour blood around obstructions in the coronary arteries, have shown promise in the relief of angina pectoris and other clinical manifestations of ischemic heart disease. An estimated 20-25,000 patients undergo the procedure each year. During FY 1973 the Institute awarded contracts for the development of detailed protocols for collaborative studies to compare the results of coronary artery bypass surgery with those obtained through medical management in clearly defined groups of patients. The goals of these trials are to ascertain the potential advantages and limitations of the procedure, whether it improves long-term survival and confers lasting benefit, and develop criteria for determining which patients are most likely to derive optimal benefit from surgery and which are best managed medically.

The Coronary Drug Project continued evaluation of lipid-lowering drugs in reducing the threat of recurrent heart attacks and improving long-term survival among men who have experienced one or more attacks. The clinical phase of this study is scheduled for completion in 1974.

Hypertension afflicts an estimated 23 million American adults. It causes about 60,000 deaths each year, and strongly predisposes affected individuals to illness or death from coronary heart disease, stroke, congestive heart failure, and kidney failure. During FY 1973 the Institute cooperated with other DHEW components, non-Federal organizations, and medical and lay communities in a nationwide program of information and education concerning hypertension. A High Blood Pressure Information Center was established within the Institute to collect and disseminate public and professional information.

The Hypertension Detection and Follow-up Program, begun in 1971 and expanded during 1972, currently is underway in 14 clinical centers around the country. These centers have begun the screening and enrollment of the 10,500 persons with mild to moderate hypertension who will participate in the treatment program. The goal is to determine the extent to which illness and death associated with hypertension can be reduced over a 5-year period of blood-pressure management.

Division of Lung Diseases

The various lung diseases falling within the purview of NHLI programs account for an estimated 150,000 deaths each year in the U.S. These diseases cause 60 million days lost from work, 40 million days of bed-restricted activity, and cost the economy about $6 billion a year in lost productivity and wages and medical care costs. Last year, the Institute convened a 12-member task force to assist the Division in identifying problems and approaches that should receive high priority. Each member also served as chairman of a panel of experts on specific respiratory-disease topics, so that a total of 188 scientists contributed to the report and recommendations published by the Institute in 1973. The report assesses the magnitude of health problems posed by particular respiratory diseases; summarizes current knowledge about causation, prevention, diagnosis, and treatment; identifies disparities between current efforts and needs in combatting those disorders; and recommends steps to strengthen research programs.

The 1973 Fiscal Year also saw the establishment of additional Specialized Centers of Research on Pulmonary Disease, 17 of which are currently operational. The research projects being pursued in these centers are many and varied. With respect to chronic lung disorders—including chronic bronchitis, emphysema, and occupational lung diseases such as black lung disease—emphasis is placed on causation, the search for effective preventive measures, and the development of techniques for detecting these disorders in their earliest stages.

Pediatric lung diseases comprise another important health problem in their own right. For example, respiratory distress syndrome is the leading cause of death among the newborn. Moreover, it is suspected that certain pediatric lung diseases may also be the forerunners of chronic lung disease in adult life.

There is some evidence that a hereditary deficiency of the enzyme, alpha-1- antitrypsin, may result in heightened susceptibility to certain forms of chronic lung disease. The Institute is supporting studies to ascertain the prevalence of the trait and to define its association with cronic obstructive lung disease, particularly among persons with strong family histories of such disorders.

Other studies are concerned with developing and evaluating improved methods of treatment and rehabilitation of patients with advanced chronic lung disease, including the management of acute respiratory crises. Oxygenators and respiratory-assist devices being developed under the Division of Technological Applications are an important part of this effort. For example, presently undergoing clinical evaluation is a capillary tube oxygenator that, in one reported instance, sustained a child for nine days and enabled him to recover from a pulmonary infection that would have been fatal.

Division of Blood Diseases and Blood Resources

The program of this Division is concerned with (1) improved techniques of blood management; (2) clotting complications of heart and blood-vessel diseases; (3) hemophilia and other hemorrhagic disorders; (4) sickle cell anemia and related disorders of the red blood cell; and (5) prevention of hepatitis and other diseases transmissable through blood and blood products.

Last June marked the completion of an Institute-supported survey of blood banking in the U.S. that yielded valuable data on (1) organizations engaged in blood banking or which influence current blood-banking practice; (2) the extent of current government regulation of the blood resource, together with recommendations for more effective regulation; and (3) hemophilia and its impact on blood resources. It also provided an overview on the present status of blood acquisition and delivery. During the year, this information was used by NHLI in planning research to improve the national network of blood donation, delivery, and utilization.

The clotting defect of hemophilia can be corrected (temporarily) by supplying concentrates of antihemophilic factor (AHF or clotting factor VIII). The simplest method of preparing AHF concentrates for therapeutic purposes is cryoprecipitation, which can be used by most hospitals or blood banks to provide AHF for the prevention or control of bleeding episodes in hemophiliacs. The Division is supporting research to improve the yield of AHF obtainable by the cryoprecipitation technique and to standardize the potency of the resulting AHF preparation.

Sickle cell disease affects an estimated 50,000 Blacks. An additional 2 million are carriers of the sickle cell trait. In 1971, NHLI was assigned responsibility for coordinating an expanded Federal program of research, training, community service, and information involving a number of NIH Institutes, HSA, and other Federal, State, and private agencies. Accomplishments of this National Sickle Cell Disease Program during Fiscal 1973 include:

- Clinical trials evaluating and comparing various methods for the treatment of sickle cell crises.
- Establishment of five new Comprehensive Sickle Cell Disease Centers to bridge gaps between basic research on the disease,

clinical application of new knowledge, and community service. Support was continued for 10 similar centers established last year.

- Establishment of 11 new screening and educational clinics and continuing support of 15 others established previously for educational, screening, diagnostic, and referral services.

Blood or blood component therapy, while often lifesaving, carries the risk that various diseases may be transmitted to the patient, the most threatening of which is hepatitis. Until the past few years, this source of infection could not be detected directly in the blood or blood products. Tests developed recently are complicated and insensitive, detecting blood capable of producing hepatitis less than one third of the time. The Institute is currently supporting research to improve the sensitivity and reliability of tests to detect hepatitis virus in blood products and to find means of removing it from contaminated samples. Also underway are studies to develop effective means of immunizing blood recipients against hepatitis.

Division of Technological Applications

This Division is concerned with the support of research directed toward reducing disability and death from respiratory and circulatory disorders through development and evaluation of devices and instrumentation for the prevention, diagnosis, monitoring, and treatment of those diseases.

During the recent years, the Division has developed several devices for providing temporary circulatory support for damaged hearts until they are able to resume their circulatory functions. Most extensively tested in clinical situations has been the intra-aortic balloon pump against cardiogenic shock. In tests thus far, the device has been found capable of stabilizing circulatory systems on the brink of collapse. But survival rates have been disappointing, probably because such devices are usually employed as a last resort in patients with irreversible heart damage.

Currently undergoing evaluation in animals is a circulatory assist system that is completely implantable and designed to operate for extended periods of time. The pump is electrically powered but can also use nuclear power sources when these become more readily available.

Substantial advances also are being made in developing materials for use in device construction that are compatible with blood, other body fluids, and tissues. Promising approaches have included hydrogel coatings and the growth of endothelial-like cells on foreign materials to provide a natural blood interface.

Intramural Research

The Institute's intramural research program blends basic research on the cardiopulmonary system with clinical studies attacking clinical problems of the disease that afflict this system.

During the year, recruitment and follow-up of patients has continued in the Type II Coronary Intervention Study. The subjects are people with familial Type II hyperlipoproteinemia, characterized by elevated blood cholesterol levels, and angiographic evidence of coronary heart disease, but not sufficiently severe to produce overt symptoms. The aim is to reduce blood cholesterol levels moderately (by therapeutic diets) or markedly (by therapeutic diets plus the cholesterol-lowering agent cholestyramine) and to assess the effects of these measures on the development, progression, or regression of arteriosclerotic deposits in the coronary arteries—again by coronary angiography.

In Fiscal 1973, the Institute also developed a fully operational Pulmonary Branch. This branch not only provides sophisticated pulmonary testing for patients enrolled in clinical studies of other branches and NIH Institutes, but has launched its own research program on various lung disorders.

Formerly part of the NHLI Molecular Diseases Branch, the Molecular Hematology Section was raised to branch status during Fiscal 1973. The Clinical Hematology Section and the clinical service of the Molecular Hematology Branch will be concerned with applying techniques of cellular and molecular biology toward understanding and treating certain human blood diseases, notably thalassemia (Cooley's anemia) and other disorders affecting hemoglobin production or the differentiation of red blood cells. The Section on Molecular Genetics will conduct research on genetic factors operative in hemoglobin synthesis and in the regulation of hemoglobin production in health and various disease states.

Also organized within the NHLI intramural program was the Metabolism Service, which will include patients from several branches, including Molecular Hematology, Pulmonary, and Molecular Diseases.

National Institute of Allergy and Infectious Diseases

Immunology, the science that deals with the protective mechanisms of the body, has long been an important research interest of NIAID. Today, it is recognized that immunology may hold the key to control of almost all diseases. Mushrooming knowledge in this field has led to impressive advances in the understanding, diagnosis, and therapy of numerous allergic and infectious diseases.

Allergy and Immunology

During Fiscal 1973, NIAID established four additional Asthma and Allergic Disease Centers, bringing the total to 14. These outpatient oriented centers are designed to shorten the time lag between research findings and clinical treatment. At one center last year, scientists gathered experimental data showing a correlation between certain clinical features of asthma and specific biochemical abnormalities, a finding that could lead to improved treatment for asthmatics.

In immunological studies, a NIAID grantee at The Johns Hopkins University demonstrated for the first time that the genes controlling expression of some allergies and the expression of the histocompatibility antigens (important in tissue typing for transplants) are linked together closely on the same chromosome. Such studies of specific allergic responses should aid understanding of the genetic control of immunity and, perhaps, lead to correction of immunologic deficiencies.

Recognizing that many fields in immunology are now ready for clinical development, NIAID established its first clinical immunology unit at Stanford University. Scientists there are taking a multidisciplinary approach to understanding and treating immunological diseases. The Institute also established three research centers in lymphocyte biology at the Albert Einstein College of Medicine of Yeshiva University, Rockefeller University, and University of Wisconsin at Madison. Findings from these centers are expected to be applied in the fight against transplant rejection and cancer.

NIAID has played a significant role in organ transplantation for nearly 10 years because the scientific problem was, and still is, an immunologic one—how to avoid or control the rejection phenomenon. The program originally focused on methods to determine the compatibility of tissues of transplant donors and recipients. This led to NIAID's development of the standardized NIH tray containing sera used in tissue matching. The tray was used last year by a majority of the U.S. transplant centers.

A NIAID contractor at the University of California, San Francisco, began evaluating the effectivenes of a standardized rabbit antilymphocyte serum (ALS) in transplant patients. ALS is a biological preparation produced by NIAID and designed to selectively suppress the immune response and protect the transplant. Meanwhile, the Institute began a 2-year, nationwide study of the unsefulness of tissue matching in kidney transplants between unrelated donors and recipients. This will seek to provide answers to critical questions being raised in the field of kidney transplantation.

Acute Respiratory Infections

Despite progress in prevention and control, contagious respiratory infections remain a significant public health problem. In the past year, one of the major NIAID efforts has been to test further a live attenuated influenza A virus vaccine developed by the Laboratory of Infectious Diseases. This new kind of influenza vaccine, was tested in about 200 young adults with no evidence of illness, and appears promising for expanded studies in the elderly and young children.

One avenue for control respiratory diseases is the use of antiviral substances. An exciting antiviral development last year was the use of interferon—a protein produced by the body in response to viruses —against the common cold. An NIAID-supported investigator successfully used interferon to prevent the common cold in human volunteers. He also found that interferon could delay the start of influenza infection but the dose given was not large enough to prevent illness. Presently, the cost of using interferon is too high to be practical. However, these studies are viewed as an important beginning in defining the minimum effective dose of interferon needed to prevent respiratory disease.

Hepatitis

Viral hepatitis remains one of the major unsolved infectious disease problems. NIAID's long range goal is control of both hepatitis A (infectious) and hepatitis B (serum). Emphasis has been placed on hepatitis B since recent knowledge of hepatitis B antigen and antibody has made it easier to study this disease. Last year, progress was made in characterizing the agent of hepatitis B in the newly found subhuman animal models. The search is continuing for animal models that combine the susceptibility to infection of the chimpanzee and the ease of handling of the rhesus monkey.

Accurate and reliable detection methods are essential for many current studies on hepatitis B. During the past year NIAID established a Hepatitis Testing Laboratory which performed hepatitis B antigen and antibody tests for the NIAID hepatitis program, and for the hepatitis programs of other NIH Institutes and the Food and Drug Administration.

Venereal Disease

Venereal disease has reached epidemic proportions in the U.S. In fact, gonorrhea is second only to the common cold as the country's most frequent contagious disease.

A reflection of NIAID's increased concern is the special emphasis research program on the basic biology of venereal disease. Many of the grants in this program are only a year old but significant findings have been made already. One NIAID grantee discovered that pili, hair-like appendages, are present on the cell walls of disease-producing gonococci but are absent from nonpathogenic types. Another grantee has developed a promising serologic screening test for gonorrhea which at present can only be detected by culturing the organism. Still another grantee showed that the chick embryo is a valuable model for studying the gonococcus organism.

Intestinal Agent

For several years Institute scientists have been on the trail of an extremely elusive virus, one which frequently sweeps through a community and causes explosive episodes of vomiting and diarrhea. Physicians refer to this condition as "acute infectious nonbacterial gastroenteritis." Using a new technique called immune electron microscopy, NIAID scientists photographed what they believe is the causative agent. Work is continuing toward isolating and growing the organism. Further studies will then be needed to determine what percent of "intestinal flu" is caused by this agent, what its impact is on the Nation's health, and whether means can be found to prevent or treat it satisfactorily.

National Institute of Arthritis, Metabolism, and Digestive Diseases

Fiscal Year 1973 was highlighted by the awarding of the Nobel Prize in Chemistry to the Institute's Dr. Christian B. Anfinsen for his pioneering research into the enzyme ribonuclease. His work is of importance in understanding the mechanisms of metabolic disorders which result from abnormal effects on protein structure and synthesis. At the same time an NIAMDD grant-supported scientist, Dr. Gerald M. Edelman, Rockefeller University, received the Nobel Prize in Physiology or Medicine for his research in immunology, which is basic to many diseases, including rheumatoid arthritis.

Arthritis

Current arthritis research is geared toward clarifying the underlying mechanisms of rheumatic diseases which is essential to the development of effective methods of prevention, control or cure. To this end, research is focused on identification of a possible viral agent, and toward elucidation of the specific malfunction of the body's immune system which seems to lead to the manifestations of rheumatoid arthritis.

Clinically, preliminary success has been reported in unexpected long term benefits in some rheumatoid patients with severely inflamed joints by injecting relatively large doses of triamicinolone hexacetonide—an adrenal cortical steroid—directly into the affected joints. Other investigators at five major medical centers have accomplished surgical replacement, with prostheses, of over 300 knee joints severely damaged by arthritis. Relief of pain and resumption of basic daily activities previously denied by joint disability were the results of this newest development in orthopedic surgery.

Diabetes

Although the basic cause or causes of diabetes are not yet known, there has been much progress in recent years in elucidating some of the disorder's many mechanisms. For example, intensive investigations are underway to determine the relationship between human growth hormone (HGH) and progressive damage to the retina of the eye (diabetic retinopathy) which develops in many persons who have had juvenile diabetes for 20 years or more.

Recent studies have shown that plasma HGH levels are significantly higher in diabetic patients with retinopathy than in those without retinopathy. Thus, it would appear that this severe eye disorder, a leading cause of blindness, develops in a milieu which includes elevated plasma levels of HGH.

Studies of diabetes in guinea pigs, meanwhile, seem to indicate that the disease could possibly stem from an infectious process. More than half of a group of healthy guinea pigs became frankly diabetic within two to six weeks after being placed in a cage with their diabetic counterparts, or after receiving injections of purified urine obtained from diabetic animals.

This study gains support from the fact that outcroppings of juvenile diabetes are reported periodically in certain areas, and from a study conducted in England which suggested that 85 percent of juvenile diabetes is preceded by an infection.

Other Metabolic Diseases

Fabry's disease is a hereditary disorder of fat metabolism, based on the absence of a specific enzyme, which results in progressive, multiple disabilities and leads to an early death. No specific treatment is effective for this inborn error of metabolism. Institute-supported research has now shown, however, that transplantation of a kidney from a normal donor can provide sufficient enzyme activity to correct the metabolic defects in Fabry's disease. Based on this experience, the kidney may be a convenient organ for future trials of "enzyme transplantation" in a variety of inborn errors of metabolism.

Digestive Diseases

Continuing studies of the use of a natural bile acid, chenodeoxycholic acid, in dissolving long-standing cholesterol gallstones has led to the conclusion that this bile acid may offer an alternative to many patients who previously had no choice but surgery. The Institute is currently financing double-blind clinical trials at nine different sites to evaluate the safety and efficacy of this particular form of therapy. It is expected that some 1,000 gallstone patients will be studied over a 2-year period in order to obtain statistically meaningful data.

In a related study, a scientist at the Institute's Phoenix Clinical Research Section has devised a physiological method of measuring human bile composition. The new procedure should prove useful in determining the effects of various diets, drugs, and diseases on the metabolism of biliary components in man, and it appears to be particularly applicable to the study of cholesterol gallstone formation.

Urologic and Kidney Diseases

The work of the Institute's Artificial Kidney-Chronic Uremia Program is especially timely since the Government has undertaken to fund dialysis and transplantation treatment of kidney patients who are covered by Social Security. Advances in this area include: development of safe, inexpensive peritoneal dialysis for home use with the aid of a permanently indwelling, trouble-free catheter; development of effective methods for preventing or treating the bone disease which afflicts many patients with chronic renal failure or on dialysis therapy; and adaptation of the principles of the special Giordano-Giovanetti diet, normally used for patients with chronic kidney failure, for intravenous use in patients with acute renal failure. The latter procedure, which involves infusion of essential amino acids, has nearly doubled the survival rate of such patients.

Several advances also have been made in the field of kidney transplantation. Among these are reduction of the toxicity of post-transplantation immunosuppressive steroid drug therapy through alternate-day dosage scheduling, and successful extension of transplantation therapy to patients with diabetes of long standing.

National Institute of Child Health and Human Development

Population, child health, and problems of the mature and aging adult are of special interest to this Institute. Research at NIH and institutions throughout the nation is centered on the continuing process of growth and development—biologic and behavioral—from conception and prenatal development through infancy and childhood and into maturation and aging.

Population Research

This country's population is expected to increase by 50 million before the year 2000. It is necessary to assess the impact of this growth on the health and well-being of children, families, and society as a whole. To accomplish this, NICHD supports research in three major areas of population:

Development of new and improved methods of contraception; study of the medical effects of contraceptives in use; and investigations of the social aspects of population.

NEW CONTRACEPTIVE METHODS

The development of new, more effective, convenient, and safe contraceptives is a goal of NICHD. Contracts have been awarded to develop male chemical contraceptives, to evaluate contraceptive activities of new drugs and devices, and to unify testing standards.

MEDICAL EFFECTS OF CURRENT BIRTH CONTROL METHODS

Past studies have suggested undesirable effects of available contraceptive methods. Results of a prospective study of 18,000 women indicate that oral contraceptives alter all physiologic processes. The net effect of these small changes over time remains to be determined. Also, scientists are monitoring the incidence of cancers of the breast and cervix to see if any correlation exists with oral contraceptive use.

Although vasectomy has become a widely accepted means of fertility control, there have been some reports of adverse effects on men and animals. NICHD has instituted a contract program to evaluate the long-term medical effects of this procedure.

POPULATION RESEARCH IN THE SOCIAL SCIENCES

The Institute supports research on the social, economic, and psychological aspects of population, with particular emphasis on factors which affect fertility and influence decisions relating to family size.

POPULATION RESEARCH CENTERS

Eight Population Research Centers, supported by NICHD, provide cooperating investigators with pooled facilities, ready access to their associates and to computers, electron microscopes, and other equipment and services.

Child Health

Another research goal is to provide knowledge to identify and treat conditions that prevent mothers from bearing healthy children. Institute studies include the development of new information about maternal and infant care, nutrition, and the design and improvement of techniques for preventing or ameliorating congenital abnormalities.

SUDDEN INFANT DEATH SYNDROME

The Sudden Infant Death Syndrome (SIDS), the leading cause of death in infants after the first month of life, claims the lives of three infants for every thousand live births. Epidemiologic studies have provided knowledge about "susceptible" infants and possible causative factors. All known associations with the syndrome appear to be intertwined.

Institute scientists are giving priority to studies of immunologic factors, infectious diseases, heart and lung function, neurologic factors (including abnormal sleep patterns), immaturity, prematurity, and intrauterine growth retardation to determine how these may relate to SIDS. The psychologic stresses experienced by families in which SIDS occurs are also under study as well as further epidemiologic studies of the victims and their families.

GROWTH AND DEVELOPMENT

NICHD supports basic research in biologic, psychologic and social aspects of development from infancy through adolescence. Special attention has been given to studies of nutrition and its relationship to mental and physical development, the development of body defenses against infection and disease, endocrine secretions and their effects, and cellular physiology as it relates to growth. Also stressed are studies of the interaction between biology and behavior, learning and cognitive development, personality and social development, and the acquisition and development of communication, including the processes of speech, language and reading.

Recently an expanded program was initiated to broaden the knowledge of adolescent development. Through research grants, conferences, workshops and publications, investigations of the individual's transition from childhood to adulthood will be organized around five areas of major emphasis—biologic processes, nutrition, intellectual development (including cognitive processes and language), socialization, and the relationship between endocrines and psychologic development.

MENTAL RETARDATION

Mental retardation is evident in some degree in about three percent of children born in this country. Although development of mental capacities is dependent in part upon a genetic blueprint, these genetic instructions, however, irrevocable, are to a large extent subject to modification by the prenatal and postnatal environment. Institute studies encompass all the forces working on the child—physical, biological, psychological, and social—in seeking to understand and prevent retardation. Twelve Mental Retardation Research Centers, for which NICHD has programamatic responsibility, have contributed to our understanding of these factors.

Progress continues in the detection and treatment of genetically created inborn errors of metabolism, such as phenylketonuria and galactosemia. A prenatal diagnostic technique, amniocentesis, shows increasing promise for detecting many of these inborn errors.

The problem of lowering the number of mongoloid births is of special interest to the Institute. Mongolism (Down's Syndrome) is known to be congenital in origin. It is also known that the incidence of mongoloid births rises precipitously among offspring of women over age 35. NICHD hopes to promote increased awareness of the risks in pregnancies among women in this age group.

Adult Development and Aging

Studies of the immunologic system, the body's defense against disease, have contributed important new knowledge about the aging process. Deterioration of this system explains the increased susceptibility of the aged to infections, such as pneumonia and possibly to cancer. Scientists working with animal models, have now learned that immune efficiency can be restored. This has been done in animals by transferring immunologically active cells from young to old animals. However, it is not yet possible in humans because of the rejection phenomenon.

An important phase of aging in women is the menopause. For reasons not yet known, cells that produce female sex hormones cease to function at menopause. The menopause is unusual in that it is the only aging process that can be treated. Although the treatment, simple hormone replacement, has been in use for many years, a great deal about it remains unknown. Moreover, the association of these hormones with serious side effects requires further clarification.

Research also is continuing in two other major areas of emphasis —cellular aging and demographic aspects of aging.

National Institute of Dental Research

Dental Caries

The problem of bringing fluorides to children in geographic areas without central water systems is receiving intensive study under the National Caries Program, established within the National Institute of Dental Research in FY 1971. More than half the population is without the benefit of fluoridated water, generally accepted as the most effective tooth decay preventive. Non-fluoride areas have a few alternatives, such as school water fluoridation, use of fluoride tablets, adding fluorides to salt, and topical application of fluorides, all subjects of investigation by NIDR-supported scientists.

Poor nutrition early in life when teeth are forming can damage them permanently. Unlike bone and other body structures, teeth cannot repair themselves after they develop even if nutrition improves. Changes in the composition, as well as consumption pattern, of snack foods is essential, NIDR investigators believe, and studies seeking substitutes for sugar (sucrose) are under way. Damaging dietary habits account for the U.S. having one of the highest rates of tooth decay in the world. Snack foods should be made more nutritious and less conducive to decay by changing both their content and their consistency.

Periodontal Disease

Today, largely as a result of periodontal disease, 23 million Americans have lost all of their teeth and another 75 million are afflicted in varying degree. Periodontal disease generally begins with inflamed gums which bleed easily. In time, the gums become detached so that pockets, in which harmful bacteria thrive, form between the teeth and the soft gum tissue. Perfectly sound teeth may eventually be lost.

In studies of this disease, dental scientists are directing particular attention to dental plaque formation, inflammation, host/parasite relationships, and bone resorption. Toxic bacterial products are now believed to be chiefly responsible for the damage caused by dental plaque. Laboratory and clinical studies have produced evidence that the inflammation of the gums is basically allergic in character. One such study covered actinomycetes, a group of suspect organisms found in human periodontal pockets and known to cause the disease in experimental animals.

Several antibiotic pastes have been shown to prevent plaque accumulations and gingivitis in humans. Currently, a mouthrinse containing chlorhexidine is being tested in Europe. It can reduce plaque and inflammation but has shortcomings which must be surmounted before the rinse can be recommended for wide-scale use.

Studies of enzymes have focused particularly on collagenase and hyaluronidase, both demonstrated for the first time in human gingival (gum) tissue by NIDR scientists. One degrades collagen, the chief protein in connective tissue, while the other breaks down hyaluronic acid, the gel-like ground substance present between collagen fibers in connective tissues.

NIDR grantees also have recently shown that levels of prostaglandins—hormones or home-like substances—in human periodontal tissue are increased in periodontal disease.

Orthodontics Turns to Computers

Computer-assisted orthodontics is one new approach to meet the problems of malocclusion—the wrong alignment of upper and lower teeth. Using a prototype of some 15,000 skull profile X-rays taken over a period of 25 years, a research team has produced a formula which employs statistics, mathematical models, and electronic technology to convert these X-rays to x-y coordinate maps of the skull and jaws. These models or maps are automatically converted to punch cards or transferred directly via telephone lines into the memory bank of a large computer. This combination of dental science and computer technology has produced the first statistically reliable pattern of human skull and jaw growth. It enables the orthodontist or other dental examiners to see the changing growth pattern of normal and abnormal cases in minutes instead of waiting years for the same events to unfold.

Other advances in orthodontics include a better understanding of forces from lips and tongue that tend to push teeth or control the position of teeth naturally, improved materials for appliance therapy, and better cements for attaching appliances to teeth. About one-third of U.S. school-age children suffer from malocclusion severe enough to require orthodontic treatment.

Improved Restorations

As part of a continuing effort, improvements are being reported in amalgam and other restorative materials. The Institute also is supporting investigations of artificial tooth implants. Preliminary studies hold promise that such implants may replace individual teeth or may serve as anchors to hold prosthetic appliances.

Viral Infections

In studies of oral ulcers, NIDR scientists have shown that, in addition to antibodies in the blood, an immune reaction associated with certain white blood cells appears to be extremely important in the defense against herpes simplex virus. This virus causes troublesome fever blisters and has been implicated in certain types of cancer.

Oral Pain Control

Oral pain control has recently been highlighted by NIDR for special emphasis. The Institute's interest in the problem extends back over a 17-year period during which its intramural investigators identified, for the first time, the full range of physiological response of healthy subjects to a variety of general anesthetic agents. Such agents and the conditions under which they are administered for oral procedures continue to be an important area of clinical research.

Institute grantees have recently reported that placing ambulatory patients in a semi-reclining (45-degree angle) position for anesthesia permits the best cardiorespiratory functioning and significantly reduces the fainting problem. There also has been initial research on ways to overcome extremely irrational fears which prevent many people from consulting a dentist. A behavioral therapist reports that fearful people can be taught to relax and, while relaxed, can then be led to visualize progressively more threatening situations such as those involved in traumatic dental treatments. These and other behavioral studies have shown the relationship between fear and anxiety and the avoidance of dental treatment. Further studies have been initiated to investigate these and other key problems in the behavioral sciences.

National Institute of Environmental Health Sciences

Research supported and conducted by the National Institute of Environmental Health Sciences is directed toward solving health-related environmental problems. Its goals are to develop understanding of the interrelationships between chemical and physical factors in the environment and human diseases and to translate this knowledge into action to diminish or relieve diseases of environmental origin. Progress toward these goals was made in both intramural and grant-supported programs during Fiscal 1973.

Environmental Health Problems

ENHANCEMENT OF HEART AND LUNG DISEASES AND CANCER BY ENVIRONMENTAL AGENTS

Over the next five years, NIEHS will invest approximately $2.9 million to support an Environmental Health Sciences Research Center to study environmental agents and combinations of agents—particularly asbestos—that contribute to heart and lung diseases and cancer. The center has been established at Mount Sinai School of Medicine, N.Y., under the direction of Dr. Irving J. Selikoff, a pioneer in asbestos epidemiology.

For nearly two decades—the last seven years with NIEHS support—Dr. Selikoff and associates have been engaged in research on asbestos as a disease-causing agent. Their studies have identified it as an important cause of lung disease and cancer among a number of types of workers occupationally exposed to it. More recently, they have begun to look at the health risks to the general population living in urban areas.

EFFECTS ON SPECIFIC ENZYMES AND OTHER CELL COMPONENTS

Conquest of disease requires knowledge of its basic causes and processes in order to develop a rational approach to prevention. NIEHS supports projects which seek to identify changes at the molecular level brought about in cells by toxic agents. In Institute laboratories, the isolated perfused lung is used to study rates of uptake, storage and release of chemicals by the lung. Two different mechanisms for uptake of basic chemicals have been identified and competition between bases for storage in the lung have been shown. Chemicals which compete for uptake can also displace one another from storage sites. Such competition might be the cause of toxic interactions of chemicals or chemicals and/or drugs in the lung and will be studied intensively.

EFFECTS ON THE IMMUNE SYSTEM

Numerous toxic agents and drug suppress the body's immunologic responses to infectious agents and foreign tissues and inevitably leads to greater susceptibility to infectious agents and intensification of infectious and allergenic diseases. An NIEHS scientist has conducted studies on the trace contaminant, tetrachlorodibenzodioxin ("dioxin"), often found in the manufacture of some herbicides and fungicides. These studies have shown conclusively that it is one of the most toxic chemicals known. The primary organs affected in adult animals appear to be the thymus and liver. Additional studies are underway to see what effect, if any, the marked thymus effect has on immune capabilities.

TERATOLOGY AND OTHER REPRODUCTIVE EFFECTS

Birth defects (teratogenic effects) associated with thalidomide have brought the dangers of birth defects due to environmental contaminants to the attention of the public and scientists. Various metals including cadmium, indium, arsenic, cobalt, zinc and mercury have been shown to produce malformations in embryos. Deficiency of zinc and manganese during pregnancy can also cause deformed offspring. NIEHS researchers have demonstrated that certain drugs and environmental agents, such as methylmercury and cadmium, can dramatically affect male reproduction. Studies were performed using a cell separation technique which allows the major cell types involved in sperm development to be isolated and studied. Biochemical studies were correlated with *in vivo* determinations of changes in male fertility in an attempt to explain and perhaps prevent this reproductive toxicity.

Other Institute scientists have developed a system for the *in vitro* culture of fertilized ova from mice, rats, and rabbits. This system can be used to study the effects of added chemicals on reproduction and gestation in ways that may help define the role of the mother in birth defects caused by chemicals and other environmental influences. It will also provide a new approach to the problem of determining what part of the unexplained majority of birth defects in animals and man comes from environmental pressures including pollutants and indirect stresses on the mother.

MUTAGENIC EFFECTS

There is some suspicion that mutagenic environmental chemicals can cause changes (mutations) in the inheritable characteristics of all organisms. The primary problems now center around the questions of whether a chemical known to be mutagenic in experimental organisms can produce mutations in man and how these effects can be measured. NIEHS is supporting several studies designed to assess various test systems for applicability to man and to develop a clearer understanding of the mutagenic process and factors that contribute to differences between organisms in their responses to specific agents.

Several NIEHS researchers have found that the process of gene mutation is under genetic control in Neurospora, a fungus or mold. Two of the strains which sensitize the genome (complete set of hereditary factors) to mutation-induction after ultraviolet and gamma irradiation are being studied to determine whether they are also more sensitive to chemical mutagens. Such strains are potentially useful for screening those environmental chemicals that are weak mutagens for mutagenic activity or for testing chronic exposure levels. Other Institute scientists are using electrophoresis to develop a simple assay to monitor the human population for gene mutations in serum proteins and various enzymes.

EFFECTS OF PHYSICAL FACTORS ON HEALTH

With the growing complexity of technology, there is growing recognition of the effects of physical factors—such as noise, microwaves and various forms of radiation—on humans. NIEHS researchers have developed exposure facilities and dosimetry techniques to study the biological effects of microwave radiation. Other scientists have found that very young animals are significantly more susceptible to intra-cochlear, nonreversable damage to hearing end organs than are adult animals, when exposed to high level noise. In addition, a direct contact transducer for delivering very precise signals to the ossicular chain of experimental animals has been developed.

BODY DEFENSE MECHANISMS

As in the case of infectious diseases, the mammalian body has a number of "built-in" defenses against damage by toxic agents. Among these are a number of enzyme systems which convert toxic agents into harmless or less toxic compounds (detoxication). At NIEHS, lung toxication-detoxication systems have been compared in newborn and adult animals and with analogous systems in the liver. Potentially important differences include a relative abundance of certain toxication systems in the lungs of newborn animals together with a deficiency in detoxication mechanisms. In liver, the two systems (toxication vs. detoxication) seem to develop together. Certain pollutants, such as mercury, affect toxication systems in lung and liver in opposite ways—stimulation in lung and inhibition in liver. Such differences in toxication and detoxication systems in different organs may result in selective organ damage, especially in the newborn, by chemicals or drugs.

Scientific Conferences and Workshops

The response to previous working conferences on current environmental problems has encouraged the Institute to extend them as a means of assessing the state of knowledge and possible impact on health and of identifying research that should be undertaken. Conferences or workshops sponsored to date include those on polychlorinated biphenyls, phthalate esters, asbestos, heavy metals, chlorinated dibenzodioxins and dibenzofurnas and mutagenesis. In addition, through its experimental journal, *Environmental Health Perspectives,* the Institute publishes conference proceedings so as to insure widespread distribution of recent experimental data.

International Programs

The Director, immediate staff and many Institute scientists are participating in the program of the Joint Committee on Health Cooperation of the United States—Soviet Union Health Exchange in accordance with the agreement between DHEW and the USSR Ministry of Health. As Head of the U.S. delegation, the NIEHS Director has made visits to and been visited by the Soviet delegation. Arrangements are now being made for exchange of specialists to work on specific topics agreed upon during the USSR delegation's visit to NIEHS in January 1973.

Under the US-USSR Environmental Protection Agreement, the Institute Director is co-chairman of the segment on the "Genetic and Biological Effects of Pollutants." A delegation of Soviet scientists visited NIEHS under this agreement in June 1973.

As part of the US-Japan Cooperative Medical Sciences Program, the NIEHS Mutagenesis branch chief is serving as U.S. chairman for the Panel on Methods to Evaluate Environmental Mutagenesis and Carcinogenesis. Following a meeting of the Joint Committee in Tokyo, a symposium on mutagenic and carcinogenic effects of environmental pollutants was held in August 1972.

National Institute of General Medical Sciences

New Cellular and Molecular Basis of Disease Program

NIGMS supports a major program of research on biological, biochemical, and biophysical processes that occur within cells in the performance of vital functions. Knowledge thus gained provides an essential base of information for investigations conducted and supported by each NIH categorical Institute and in nearly all areas of medicine. During the past year, support for these studies was reorganized under a new Cellular and Molecular Basis of Disease Program.

A key challenge is to determine the structure of medically significant proteins in hope of their eventual synthesis and therapeutic use. This is important because of the growing demand for human protein substances, such as insulin to aid diabetics and blood clotting factors to treat hemophiliacs. NIGMS grantees William H. Stein and Stanford Moore, Rockefeller University, have recently advanced this field by demonstrating the primary and secondary structure of proteins and enzymes. For this work they were awarded the 1972 Nobel Prize for Chemistry along with Dr. Christian B. Anfinsen, NIAMDD.

Genetics Program

The NIGMS program in genetics seeks better understanding of basic genetic processes and mechanisms in order to improve the prevention and treatment of human heritable diseases. Genetic disorders, now recognized as one of the Nation's foremost health problems, are the leading cause of death among infants in the first year of life. Heritable factors also play a major role in the susceptibility of thousands of persons to such chronic disorders as hypertension, arteriosclerosis, arthritis and at least several forms of cancer.

A recent NIGMS-supported advance in human genetics research concerns the enzyme, aryl hydrocarbon hydroxylase (AHH), which modifies a wide variety of hydrocarbons, including many drugs, insecticides, and chemical carcinogens. The amount and activity of this enzyme increases when individuals (or, experimentally, their white blood cells) are exposed to such agents. Recently, it was found that the degree to which additional enzyme is induced varies in different individuals, and is a heritable trait. Clinical studies also have shown that cigarette smokers with the "high inducibility" trait are far more prone to develop lung cancer. Work is now underway to devise a simple blood test which should enable individuals with a great genetic predisposition toward lung cancer to take more stringent precautions with regard to smoking and exposure to other carcinogens.

Another finding centers on the role of excess cholesterol as a hereditary factor in heart disease in general and, in particular, in the heritable disorder called dominant familial hypercholesterolemia. This disorder, characterized by extremely high blood cholesterol levels, usually result in death from coronary vascular disease by age 30. The basic defect in this condition has now been identified and demonstrated in tissue cultures from the skin of patients.

In general, the synthesis of a key enzyme in cholesterol biosynthesis is reduced when there is sufficient cholesterol-containing lipoprotein in circulation. However, it has been shown that such feed-back control is absent in these patients, who therefore synthesize abnormally large amounts of enzyme and thus, also, excessive cholesterol. Most important, this demonstration of one of the predisposing factors in heart disease, in tissue culture, and in an extreme form, will permit future investigations on new approaches to drug therapy. In addition, tests for genetic predisposition toward high cholesterol levels can now be developed, and suitable preventive regimens can be prescribed early in life.

Pharmacology and Toxicology

Institute support of fundamental and clinical studies in pharmacology and toxicology is devoted to greater understanding of the basic biological activity of drugs as they are administered to patients alone, in combination, and under varying states of health. Scientist grantees this year found that the widely-used anticonvulsant drug, diphenylhydantoin, blocks the action of tolbutamide to lower blood sugar, which could endanger diabetic patients. Others showed that poor nutrition, protein depletion, and Vitamin C deficiency increases toxicity of the antibiotic chloramphenicol, appetite-supporting amphetamines, barbiturate sedatives, and other drugs. Still another investigator found that premature infants fail to metabolize the tranquilizer drug, diazepam, and that it is metabolized only partially by full-term infants compared to older children. Yet other studies revealed that the diuretic drug, acetazolamide, which effectively reduces blood pressure also exerts a similar effect on elevated spinal and eye fluid pressures. This strongly suggests that it may be beneficial to many patients with abnormally high cranial fluid pressure due to head injury and to others who suffer the eye fluid build-up of advanced glaucoma.

Engineering in Biology and Medicine

Support in this field brings together the talents of physicists, life scientists, physicians and engineers in the development of new instruments and devices applicable in medical research and patient care. One important goal is to develop new knowledge and techniques to improve the diagnosis of disease using radiation, radioisotope and ultrasound technologies. One such development is a promising new method to visualize tissue damage associated with heart attacks. The technique employs a solution of ammonia labeled with the short-lived isotope N^{13} which, infused into the blood circulation, begins to concentrate in the heart tissue within 30 seconds. The concentration which lasts for about a half-hour, takes place in heart areas where the blood supply is intact but not in areas of infarction. Images produced by the radioactive ammonia are recorded radiographically, providing a highly definitive picture of the extent of damage which conventional X-rays of the heart do not reveal.

Trauma

The NIGMS Trauma Program seeks better ways to prevent death from injury, mitigate pain, speed recovery of patients, and lessen the disability caused by injuries. A frequent, widespread complication of injury is the formation of blood clots, particularly among patients suffering hip fractures or who undergo surgery in the abdominal and leg areas. These large thrombi often break away from the vein wall and are carried to the lungs where they lodge and stop further blood flow—causing the often fatal condition called pulmonary embolism. Recently, a research team at the University of Cincinnati's General Hospital Trauma Center developed a new filtering technique that prevents clots from entering the hearts and lungs. Collapsible mesh filters inserted into the vena cava below its opening into the heart were tested the past year in 41 hip fracture patients. It was found that the clinical signs of pulmonary distress were seven times less in the patients who had the filters than in those who did not. The filtering technique showed a decided improvement in mortality rates over the use of anticoagulant drugs in high risk patients.

Anesthesiology

Basic and clinical research in anesthesia are supported by the Institute as a basis for improved care to patients requiring surgical procedures, respiratory assistance, or relief from chronic pain. A major cause of respiratory failure and death in premature babies is hyaline membrane disease marked by the buildup of protein materials inside the tiny air sacs of the lungs. This disorder is estimated to kill 25,000 infants in the U.S. annually. Clinicians in San-Francisco have been able to increase markedly the survival of such infants through the use of a positive-pressure respirator which keeps the lungs inflated between breaths for better absorption of oxygen. In this way, many afflicted infants who otherwise might have died were maintained through the crucial time period required for them to adapt to the external environment and gain the strength to breathe on their own.

Acupuncture

The NIGMS, which has responsibility for acupuncture research, convened early in 1973 the first Acupuncture Research Conference. More than 100 physician and scientist participants from 25 medical schools gave preliminary reports of their investigations. The consensus was that while acupuncture may very well contribute to the relief of some painful conditions, it is no panacea and further research probably will be necessary before its place in U.S. medicine can be determined.

National Institute of Neurological Diseases and Stroke

Stroke

In the area of stroke, third largest cause of death in the United States and probably the leading cause of long-term disability, NINDS has moved ahead on several fronts. Special attention is now being focused on the problem of the "little stroke" or transient ischemic attack, often a forewarning of a major stroke, and which offers opportunities to study the initial dynamic mechanisms involved. In addition to the Institute's 13 clinical research centers, 10 new centers for research in problems of acute care have been established this year at the following universities: Iowa, Virginia, Utah, Johns Hopkins, Wake Forest, Michigan, Ohio State, Alabama, Rochester, and Loma Linda. These new units are developing methods for preventing small strokes, and for treating the acute phases of major, life-threatening strokes.

A striking new development in neuroradiology is computerized soft-tissue tomography, which is about 100 times more sensitive than conventional X-ray systems. The equipment, produced by a British Company (EMI, Ltd.), scans the patient's head at high speed, and feeds the results into a computer which prints out absorption coefficients of the tissue, blood, or other material at each of 28,000 points along the scan. An oscilloscope picture is also produced. So far, the scientists have been able to detect small cysts, neoplasms, abscesses, and, of special interest in stroke, infarcts and hemorrhages.

Several U.S. institutions having large stroke patient populations have installed the new scanners, and Institute scientists have entered into consultations and undertaken planning regarding their many possible uses in research.

Several promising projects were reported dealing with development of prosthetic devices for stroke patients. One group has developed an electrical brain stimulator with implanted electrodes, controlled by a computer, which can make a rhesus monkey with an artificially paralyzed arm reach out, grasp an object (such as food), and bring the object rapidly and smoothly to its mouth.

In stroke epidemiology, the Institute has begun a study in Panama aimed at throwing some light on the question of why stroke is more prevalent among Blacks than Whites. The approach will be to study incidence of a risk factor—hypertension—among three groups of

Blacks with fairly common heredity but with differing environmental backgrounds going back several generations. Conducting the study in Panama avoids the factors of high mobility and rapid urbanization which would complicate it in the U.S.

Spinal Cord Injury

In the area of trauma to the nervous system the Institute's five head injury clinical research centers have been supplemented by three acute spinal cord injury research centers. These groups are actively exploring means to decrease the incidence and severity of the paralysis following injury to the spinal cord, and are conducting research in the fields of neural prostheses and nerve regeneration.

Multiple Sclerosis

Multiple sclerosis presents a discouraging picture for several hundred thousand Americans in early adult life. No effective treatment is yet available but the Institute is pursuing many avenues of research which are providing information about potential causes of the disease, such as sensitization of the patient's immunological system to his own brain tissue by a viral agent or other mechanism.

In addition to the Reed Neurological Research Center at UCLA, the Institute is now supporting a combined clinical and basic research center in multiple sclerosis at the University of Pennsylvania and Wistar Institute in Philadelphia. It also is supporting the National Advisory Commission on Multiple Sclerosis which is now in the final phases of producing a comprehensive report on new approaches to research and care in this field.

Epilepsy

The Institute maintained intensive programs to learn more about the causes of epilepsy, and continued to study the effectiveness of antiepilepsy drugs in general. Additionally, the search for new drugs continued. Gas-liquid chromatography (GLC), a valuable technique in both research and treatment, was further refined and considerable time and effort went into making the technique better known among neurologists and physicians generally. Work began with the National Bureau of Standards to develop GLC standards which can assure accuracy by all of the increasing number of laboratories that are offering the service.

Hearing, Speech, and Language

The Section on Communicative Disorders, established in 1972, is developing and supporting research on improving diagnosis and treatment of disorders of hearing, speech, and language. The section is currently supporting studies on early detection of hearing loss in infants and young children, and is developing plans for studies on aphasia and treatment of speech disorders.

In conjunction with the newly-established Section on Biomedical Engineering and Instrumentation, it is supporting development of wearable master hearing aids whose characteristics can be tailored to fit specific needs. The two sections are also supporting work on a speech analyzing aid to augment lip-reading.

Inborn Errors of Metabolism

NINDS scientists have discovered that the biochemical defects in the genetically determined lipid storage diseases (Gaucher's disease, Niemann-Pick disease, Fabry's disease, Tay-Sach's disease, etc.) are in all cases a lack or failure of a key enzyme in the pathway for degradation and disposal of the specific lipid that accumulates in tissue cells in each disorder.

On the basis of this knowledge, simple tests have been devised to diagnose suspected cases, identify carriers, and to monitor pregnancies. Efforts are being directed toward isolation and purification of the needed enzymes and development of procedures for possible replacement therapy.

Slow Virus Research

A long-term NINDS study has shown that a number of degenerative diseases of the nervous system represent slow virus infections manifested many years after initial contact with the virus. Some can be experimentally transmitted, to chimpanzees, but only after extraordinarily long incubation periods (up to 8 years). The diseases studied are mostly very rare, but the work raises obvious fundamental questions: How many *common* degenerative disorders of the nervous system may be caused by slow viruses? Could slow viruses contribute to aging? Could they cause multiple sclerosis, and other sclerosing diseases? These studies are potentially some of the most significant and provocative in the entire program.

Bureau of Health Manpower Education

During its fifth and final year as an NIH component, the Bureau of Health Manpower Education continued its efforts to raise the caliber of health manpower training and enlarge the nation's force of physicians, dentists, nurses and other health personnel. Emphasis was placed on educating health personnel in underserved areas, recruiting disadvantaged students for health careers, training physician assistants and nurse practitioners and developing health manpower information.

More than $10 million was awarded in contracts by the Bureau's Office of Special Programs to 11 medical schools to establish Area Health Education Centers (AHECs). The AHECs, which link health service organizations and educational institutions, were set up to train health manpower where it is needed most. About 3,300 persons, ranging from nurses aides to practicing physicians, received training in AHEC programs in the 1972-73 school year.

About $6.2 million also was awarded in contracts and grants to institutions in 24 States and the District of Columbia to train physician assistants for primary care. An estimated 1,900 trainees will be enrolled during the 1973-74 school year in programs supported by the Office of Special Programs. In the 1972-73 school year, the first year of the program, there were 1,400 enrollees, of whom 300 graduated. Graduates assist physicians practicing family medicine, internal medicine, obstetrics, pediatrics or emergency medicine.

The Bureau's Office of Health Manpower Opportunity awarded $5 million in grants to increase the number of minority physicians, dentists and other health professionals. The Special Health Career Opportunity Grants were awarded to institutions and organizations in 21 States and the District of Columbia. About 3,000 trainees are expected to be enrolled during the 1973-74 school year in programs supported by these grants. About 2,500 were enrolled in the 1972-73 school year, the first year this training was supported.

In Fiscal 1973 the Bureau operated at a level of $477,018,000 under a continuing resolution as compared with appropriations of $673,600,000 in FY 1972. There were 759 permanent full-time employees on duty as of June 30, 1973.

The Bureau, which joined NIH in 1968, was transferred on July 1, 1973 to the new Health Resources Administration. Two new divisions, Comprehensive Health Planning Service and Health Care Facilities Service, were added to the Bureau and it was renamed the Bureau of Health Resources Development.

Division of Physician and Health Professions Education

The Division of Physician and Health Professions Education, which has major responsibilities for carrying out the Comprehensive Health Manpower Training Act of 1971, awarded more than $300 million in grants and contracts during Fiscal 1973 to health professions schools for programs authorized by the Act.

More than $152 million in capitation grants was awarded to 286 health professions schools in 47 States, the District of Columbia and Puerto Rico to support educational programs and increase enrollments.

ENROLLMENT INCREASE

For the school year beginning in the fall of 1973, the schools assured an expansion of first-year enrollment to almost 31,000, about 400 more than the previous year. Medical and osteopathic schools were expected to increase first-year enrollments to 14,840 this fall, about 380 above the previous year.

Grants totaling $50.4 million were awarded to 10 health professions schools, including six medical schools, for construction of teaching facilities. These funds are expected to result in the addition of more than 630 first-year places at these schools.

Slightly more than $36 million in special project grants was awarded to health professions schools. The 232 grants were awarded to assist them in carrying out such projects as expanding enrollments, shortening the training period, teaching family medicine and clinical pharmacology and increasing the enrollment of students from low-income and minority groups as well as those who may practice in rural or other shortage areas.

FAMILY PRACTICE

Fifty-one hospitals received $5 million in grants to train physicians in family practice. About 785 residents are being trained in family practice in programs supported by the Division.

Eighteen health professions schools received more than $9 million in financial distress grants. Seventeen grants were awarded to help schools meet 1972-73 operating deficits. The other was intended to aid a school with special need for financial assistance to meet accreditation requirements.

A total of $6.3 million in grants was awarded to the University of Hawaii and Brown University to convert 2-year medical schools into M.D. degree-granting institutions. Both schools were to enroll their first third-year medical students in the fall of 1973—66 at

Hawaii and 60 at Brown—and award their first M.D. degrees in 1975.

Nine health profession schools received grants totaling $1 million for teaching training programs designed to improve the teaching skills of health professions teachers.

STUDENT ASSISTANCE

More than 30,000 students are estimated to have received student aid funds totaling $36 million in health professions loans and $15.5 in health professions scholarships.

A variety of educational experiments were funded through contracts totaling $8.4 million, about $2.7 million more than a year ago.

The University of California at Berkeley received funds to undertake an experimental program designed to prepare graduate students for entry in advanced standing to medical school. Aspiring medical students are to receive two years of preclinical training in regular graduate facilities before being admitted to medical student school as third-year students.

COMPUTER-ASSISTED INSTRUCTIONAL MATERIALS

The University of Illinois at Champaign-Urbana was awarded a contract to develop and test computer-assisted instructional materials for use in its School of Basic Medical Sciences. The school will devise for use in its PLATO (Programmed Logic for Automatic Teaching Operation) System teaching materials for first-year medical students.

The Medical College of Pennsylvania was awarded funds to undertake a part-time residency program designed primarily for physicians who are currently inactive, such as women with family responsibilities.

Boston City Hospital, Washington University School of Medicine in St. Louis and Stanford University Medical Center received contracts to develop and operate residency programs in primary care for internists and pediatricians.

The University of Colorado Medical Center received a contract to operate a program in which health professions students gain experience in summer by helping provide care for migratory farm workers.

The University of Maryland School of Dentistry received funds to devise a method of determining which prospective dental students are likely to practice in rural or other shortage areas upon graduation.

Division of Nursing

Topmost priorities focused on training and research in expanded roles for nurses, broadening the socioeconomic base for recruitment, and increasing health resources for underserved areas. Related activities centered on nurse manpower information and management of patient-care data.

Almost 3,800 grants and contracts, including 948 basic support grants to schools and 170 special project awards, totaling $98.2 million were awarded to advance nursing education and research. Approximately 22,000 students received loans for nursing education and 11,000 received scholarships. Some 1,400 registered nurses received traineeships for long-term study to prepare for teaching and other leadership positions.

EXPANDED ROLES

A contract was awarded to the University of Washington School of Nursing for an interdisciplinary master's level program to develop family and community health nurse practitioners with strong capabilities in prevention and primary care for residents of urban and rural areas. As a result of 15 contracts awarded in Fiscal 1972, 311 nurses were enrolled the past year for practitioner study ranging from several months to a year in fields including pediatrics, midwifery, family-oriented nursing, medical nursing, and maternal health. Some 278 completed training.

The University of Texas Southwestern Medical School and Texas Woman's University are developing the first master's level program to prepare practitioners, teachers, and researchers in the care of burns. Research supported at Yale University resulted in a program to prepare nurses for expanded roles with ambulatory children and adults. The first study of the family nurse practitioner, under way at the University of North Carolina, is developing methodology for evaluating this category of nurse.

The first national conference on research and education in the expanded role, supported by the Division is expected to result in a comprehensive plan for research and demonstration in expanded nursing practice. The first conference to advance biologically-oriented exchange between nurse clinicians and researchers was held by one of the nine institutions participating in research training grants. Under the Division's program of individual Special Nurse Fellowships for Research Training, 52 nurses received doctorates.

MINORITY RECRUITMENT

Grants were awarded to develop a bilingual approach to nursing recruitment and education at Navajo Community College in Arizona and an associate degree nursing program at the Lakota Higher Education Center on the Pine Ridge Indian Reservation in South Dakota. During its first 18 months the "Breakthrough to Nursing" project of the National Student Nurses' Association enrolled 400 minority students, retained 500 in R.N. programs, and produced a manual to help high school counselors recognize nursing potential.

In a study at the University of Florida, hospitals and nurses will be surveyed to determine which benefits would attract nurses to shortage areas. The National League for Nursing is studying work patterns and extent of geographic mobility among new nurses.

NURSE MANPOWER

Nurse staffing studies were started in California and Oklahoma Hospitals. A cooperative study with the American Hospital Association is documenting relationships between specified characteristics of hospitals and staffing for nursing. Research supported at the University of Iowa resulted in Division publication of a source book on staffing methodology. Eight States and Territories received consultation on planning for suitable nursing resources.

In cooperation with National League of Nursing, a conference was held on management information systems for community health agencies. A data collection and retrieval system developed with Division aid by the New Jersey State Department of Health is being implemented in agencies statewide.

Division of Allied Health Manpower

Division efforts were directed primarily to improving the effectiveness and efficiency of allied health professions education opportunities. Initial steps also were taken toward new approaches to allied health professions credentialing practices. Efforts were continued to improve capabilities of public health graduate training programs and to prepare manpower for positions in new and emerging health services administration settings.

The Division awarded $7 million in Special Improvement Grants to 138 junior colleges, colleges, and universities for enrollment expansion, curriculum improvement and program coordination. Funds also were used for programs for veterans and the disadvantaged.

NEW OCCUPATIONS

Grants and contracts totaling $8.7 million supported activities to develop new educational techniques and methods, new types of health personnel, and strengthening of allied health professions training.

Grants to institutions totaling $3.7 million aided more than 5,500 persons to obtain advanced training as allied health educators, administrators, supervisors and nonresearch specialists.

A total of $8.7 million was awarded to 18 accredited schools of public health and other institutions offering graduate public health training for curriculum improvement and development.

During the Fiscal Year almost 10,000 trainees received financial assistance for graduate public health training.

Operation MEDIHC (Military Experience Directed Into Health Careers), a State-oriented counseling and referral program, assisted 6,100 veterans in Fiscal 1973 to find jobs or training allowing them to capitalize on their military experience.

NATIONAL CERTIFICATION

The Division contracted with the Institute of Public Administration for a Feasibility Study of National Certification of Allied Health Manpower to determine the feasibility of establishing a national system of health personnel certification to which interested health groups could relate their specific requirements.

Contracts also were awarded for the development of proficiency tests for inhalation therapists, occupational therapists, radiological technologists, and physician assistants.

The Association of Schools of Allied Health Professions received funds to determine the barriers preventing minorities from entering allied health occupations.

Division of Dental Health

Training in Expanded Auxiliary Management (TEAM) grants funded 17 programs totaling $4.8 million to teach dental students to work with auxiliaries trained in expanded functions. The TEAM program is an outgrowth of the Dental Auxiliary Utilization (DAU) program which has been supported by the Division since 1961. DAU training programs now are required to be part of the curriculum in all U.S. dental schools.

The Dental Manpower Development Center, Louisville, Ky., was the site of 15 TEAM training conferences for dental faculty, dental association representatives, auxiliary supervisors, members of State boards of dental examiners, and directors of the U.S. Army's TEAM program.

PROJECT ACORDE

Project ACORDE (A Consortium on Restorative Dentistry Education), developed with Division leadership and support, has completed detailed task descriptions of 75 restorative procedures. Instructional modules for these procedures are being developed. Project ACORDE is a nationwide collaborative effort to develop standardized materials and teaching methodologies for the training of expanded function dental auxiliaries.

In contractual agreement with the World Health Organization, the Division began an international collaborative study of representative dental care systems in six foreign countries. The Division also awarded a $192,619, 2-year contract to the University of Maryland School of Dentistry to study private dental practices in the U.S.

PREVENTIVE DENTISTRY

Public education activities in support of community water fluoridation were continued in FY 1973. Georgia and Nebraska enacted laws requiring fluoridation statewide, bringing to nine the number of States with such legislation. As of December 31, 1972, fluoridation reached almost 98 million people—approximately 60 percent of those on public water supplies or 46 percent of the population. Contracts totaling $286,133 were let to provide initiative to six States in the development of school water fluoridation programs to extend the benefits of fluoridation to rural areas without a central water system.

Projects were funded in elementary schools in Houston, Tex., and Tacoma, Wash., to demonstrate and evaluate new dental health education programs.

Guidelines for dental services in the implementation of the Early and Periodic Screening, Diagnosis, and Treatment Program were developed in conjunction with the Social and Rehabilitation Service. The guidelines, issued by SRS, establish the basic dental care procedures for eligible recipients in all State medicaid programs.

CONTINUING EDUCATION

In July 1972, Division support was given to the University of South Dakota for a regional feasibility study of continuing dental education programming using educational television as the primary medium. The project is in conjunction with the television series produced by the Minnesota, Iowa, Nebraska, and the Dakotas Corporation for Regional Continuing Dental Education through a DDH contract. Training sessions were designed to prepare practitioners and dental school faculty to utilize TV more effectively as a teaching tool.

Division of Manpower Intelligence

Major activity occurred in Project SOAR (Supply, Output and Requirements) to synthesize information on the current resource pool covering a broad range of health occupations and to project profiles of this pool to 1990. A by-product of the project has been a significant advancement of the state-of-the-art in manpower analysis.

HEALTH MANPOWER PLANNING AT STATE AND LOCAL LEVELS

Bureau program decentralization and the accompanying increase in regional and State responsibility for health manpower planning led to a large-scale effort to inventory such activities.

MANPOWER INFORMATION SYSTEMS

There has been a significant expansion and refinement of the Bureau's data bases, e.g., those covering foreign medical graduates, minority group members, and women in the manpower supply pipeline and in the current resource pool. Several computer-based information systems were initiated or expanded including the Bureau Management Information System; the Manpower Analysis System; the Area Resource File; and the Grants and Contracts Information Exchange System.

MANPOWER INFORMATION EXCHANGE

A quick-response capability was developed to service information requests from legislative and executive offices at all levels. Considerable emphasis was placed on acquiring and disseminating manpower planning information. Literature searches and bibliographies were formalized. The Bureau reference library operations also were expanded.

INTERNATIONAL HEALTH MANPOWER

Methods of national health manpower planning in the USSR, the United Kingdom, Sweden, Finland, and Germany and their relevance for the United States are being described and assessed. Information on health manpower use, education, and regulation in Australia, Canada, Belgium, and Norway and an analysis of the implications for the U.S. are also being provided. A monograph on foreign-trained physicians in the U.S. also was published.

National Library of Medicine

In a new cooperative venture between NLM and the Library of Congress, 30 major medical publishers print full cataloging information in new publications from data generated by NLM. During the first year of operation of the Cataloging-in-Publication (CIP) program, approximately 1,000 medical titles were cataloged. As the program grows, the cost of duplicative cataloging by other medical libraries should be substantially reduced.

Requests by other libraries for material in the NLM collection hit a new high in Fiscal 1973—over 165,000. Indicators of service were also up for reference and acquisitions activities. Because large backlogs have been eliminated, the number of articles indexed for *Index Medicus* showed a decrease to 207,000.

On-line Services

Fiscal Year 1973 saw the extension of MEDLINE (MEDLARS on-line) bibliographic retrieval services to more than 180 institutions around the Nation. In addition, the Library developed plans to put cataloging, serial locator, audiovisual, and other information on-line in the near future. Because of NLM's expanding activity in this area, the NLM Board of Regents approved a policy statement governing the provision of on-line services by NLM, including program objectives, operating model, and specific responsibilities.

MEDLINE

The growth of MEDLINE—the service which provides almost instantaneous, interactive searching of over 477,000 citations to articles from 1,200 of the world's leading biomedical journals—has been dramatic, increasing from 5,036 searches performed in July 1972 to 17,933 in June 1973. Nearly all U.S. medical schools and many hospitals are now users of MEDLINE, with access available in every state in the U.S., as well as in Canada, France, Sweden, Denmark, Finland, and Norway.

Particular emphasis was placed during Fiscal 1973 on extending MEDLINE services to large community hospitals and clinical centers concentrating on direct patient care and health-related educational and research efforts.

TOXLINE (formerly TOXICON)

The on-line toxicology literature retrieval service, TOXLINE, has been offered to the biomedical community as a subscription service since October 1972. Managed by the Library and operated by a contractor, TOXLINE contains a data base of citations enriched with index terms or full abstracts dealing with the toxicology/pharmacology of drugs, pesticides, industrial chemicals, environmental pollutants, and hazardous chemicals used in the household.

The service is available for an initial fee of $350 to cover training and user support, and a cost of $45 per connect hour for remote terminal access. Communication with the system is accomplished through terminals which link users to a computer through the same communications network that supports MEDLINE. As of June 1973, the service had 35 private industry, government, and university subscribers. Efforts are underway to expand the number of users and to create a TOXLINE Chemical Dictionary to further assist users in the retrieval of chemical substance names and an interactive Toxicology Data Bank with information on hazardous compounds.

Experimental Networks

At the end of the Fiscal Year, the Library's Lister Hill National Center for Biomedical Communications had three experimental networks in operation: (1) the Alaskan Experimental Network, using the ATS–1 satellite; (2) the New Hampshire/Vermont Medical Interactive Television Network, using a microwave network to bring the medical school classroom to the small community hospital; and (3) the Computer Assisted Instruction Network. The CAI experiment, the newest of the three, began operation in July 1972 with the connection of the Massachusetts General Hospital computer center to the Tymshare network—the same network providing the communications link for the MEDLINE service. Since then two additional computer centers, at Ohio State University College of Medicine and the University of Illinois Medical Center, have been connected. The three centers offer a variety of course materials, including patient simulations, multiple-choice test items and training programs for paramedical personnel. Currently, there are over 60 organizational users. Two different types of networks are in the planning stage: health experiments using the ATS-F satellite, and the use of cable television for health education.

Audiovisual Programs

The Library's National Medical Audiovisual Center in Atlanta continued efforts to develop an automated data base containing information on nonprint instructional materials available for education in medicine and allied health sciences. Approximately 1,800 items have been evaluated, cataloged, indexed, and keypunched. Other areas of emphasis included developing preliminary specifications for an audiovisual systems information dissemination program and increasing the number of experimental workshops to explore team techniques for instructional media development.

Grants for Library Assistance

This year marked the expiration of the first extension of the Medical Library Assistance Act and the enactment of a second extension. All programs contained in the initial 1965 legislation were renewed except the Medical Library Construction Program, which was repealed.

LEGISLATIVE HISTORY

P.L. 89–291	Period Covered	Total Appropriated
Medical Library Assistance Act of 1965	July 1, 1966–June 30, 1970	$41,306,000
P.L. 91–212		
Medical Library Assistance Extension Act of 1970	July 1, 1970–June 30, 1973	$19,506,000

NLM now provides grant support for research, improvement of library resources, training, special scientific projects (Distinguished Scholar Award), biomedical publications, and Regional Medical Libraries.

Publications

The Library published the following new titles during the year: *Drug Interactions—An Annotated Bibliography with Selected Excerpts (1967-1970), Index of NLM Serial Titles, Bibliography of Audiotape and Tape-Slide Programs Applicable to Undergraduate Medical Education,* and *A Guide to Computer-Assisted Instruction in the Health Sciences.*

Clinical Center

The Clinical Center provided clinical research facilities and quality patient care services for the National Institutes of Health during FY 1973, and provided opportunities for young physicians and other professionals to prepare for careers in research or academic medicine.

Renovation of Outpatient Facilities

Although construction of an Ambulatory Care Research Facility is planned to accommodate a projected 140,000 outpatient visits per year by 1980, it became evident that additional space and equipment would be needed to care for the increasing number of outpatients during the interim. Thus renovation of the existing outpatient department began in December 1972, to be completed in three phases: North Wing, 120 days; South Wing, 90 days; West Wing, 90 days. Improvements in the arrangement of examining and special treatment rooms will enable the staff to more effectively handle outpatient activities which are expected to expand to 23,400 visits in 1968, 32,000 in 1971, 48,000 to 50,000 visits in 1975.

Diagnostic Radiology

Changes and new programs initiated by the Diagnostic Radiology Department during the year improved patient care. A greater number (1,935 studies) and wider variety of radiological examinations and special procedures were performed. Reorganization of the medical transcribing section assured the most expeditious reporting of examinations. The patient waiting facilities were remodeled to accommodate the increasing outpatient load. Establishment of weekly film review conferences led to a closer working relationship with Institute clinicians. Initiation of an organized film and slide teaching collection proved helpful to both the department's staff and to NIH clinicians. In addition, a radiographic research room was made available to support the staff's growing interest in performing independent radiological research.

Perinatal Addition

Construction of a 3-story addition to the D Wing of the Clinical Center continued during the year. This addition will accommodate research programs in reproductive biology and perinatal biology of the National Institute of Child Health and Human Development.

It will provide space for general laboratory modules, offices for researchers, patient care and support facilities, a labor-delivery suite, and a neonatal care unit. Expected occupancy date is July 1974.

Management Systems Progress

Capitalizing on a gradual build-up of computer systems capabilities, the Office of Clinical and Management Systems has undertaken 16 projects. For example, in FY 1973 a Medical Record Discharge Diagnosis Data Acquisition and Retrieval System was developed in cooperation with the Division of Computer Research and Technology to provide in readily processible form coded discharge diagnosis information on all inpatients admitted to the Clinical Center.

Medical Board

To assure more intensive and careful review of all aspects of clinical research to safeguard patient participants, two non-M.D. NIH staff members and one non-NIH physician in the community were named to Medical Board membership during the year.

Fogarty Scholar

Dr. Charles S. Davidson, Harvard Professor of Medicine and an outstanding medical administrator, arrived in December 1972 to participate in the Scholars-in-Residence program of NIH's Fogarty International Center. Six months of his NIH stay were spent at the Clinical Center, working closely with the Director and young clinicians on postgraduate education in a research environment.

Patient Load

Patient admissions numbered 4,585. Outpatient clinic visits rose to 39,911, an increase of 1,714 during the previous 2-year period.

The average length of stay remained approximately the same, 26 days. The total number of patients admitted to the Clinical Center from July 6, 1953 through June 30, 1973 was 71,683.

Division of Computer Research and Technology

Services and Facilities

The use of NIH central computing power increased again in Fiscal 1973. The work load rose from 125,000 to 140,000 jobs per month as a result of the increase in interactive terminals from 400 to 600, and the number of remote job entry terminals from 27 to 50. During the year the central facility was changed from a 3- to 4-computer configuration, increasing the processing power and lowering cost per job slightly.

Systems Development

Two software packages designed at DCRT gained prominence, and approval, during the year. The first of these systems, known as "shared spool," allows the four large independent computers to be operated as a single, more efficient, network. This linkage also cuts the manpower operating requirements to 60 percent of that needed for four independent machines.

The second software package, known as the DCRT Data Management System, was designed to meet the needs of individual researchers and managers at NIH. It allows file creation, updating, editing, maintenance and retrieval from a computer data base with very little programming on the part of the user. It also allows users to set up their own data-naming convention to control maintenance and retrieval functions related to the data base.

Research Developments

Solving problems of biomedical importance is becoming increasingly dependent on the analysis of large, variegated data bases. As more data are gathered, it becomes important to recognize patterns, to classify and to model the underlying biological and physical systems which are generating the data.

This principle has been applied to many of the research studies, both collaborative and individual of the Division. NIH clinical staff and DCRT scientists have used it in the critical evaluation of computer programs which analyze the electrocardiogram, for analysis and interpretation of "normal variation" in blood chemistries, and for the analysis of nuclear isotope data used in organ function tests and disease diagnosis.

Formal mathematical methods are being studied for application to tissue typing procedures. Manual interpretations of typing data is inadequate; the mathematical approach will deal with the complex data in terms of distinguishing insightful patterns. Other noteworthy research involved continued progress in the quantitative elucidation of the electrostatic (Coulombic) and electrodynamic (van der Waals) forces that play an important role in determining chemical and biological structure.

Education

Computer courses which DCRT offered to NIH staff increased to an all-time high of 40 at one time. More than 2,000 applications were processed.

A Clinical Elective in "Computers and Clinical Medicine" was offered for the second time. The 9-week course is now an advanced elective for students with prior experience in computing.

Division of Research Grants

A report of the special session entitled, "The project-grant application of the National Institutes of Health," presented at the April 1972 meeting of FASEB was published in *Federation Proceedings*, Vol. 32, No. 5, May 1973. Ten thousand copies were reproduced for distribution to the scientific community by the Division staff.

The Division processed 24,083 competing and noncompeting research grant applications of which approximately 14,500 were assigned for technical merit review during Fiscal 1973.

Research training applications of all types received and processed during Fiscal 1973 decreased slightly from 10,933 the previous year to 10,813. Fellowship applications increased from 4,019 to 4,354.

As a result of the phaseout of research training programs, announced in January 1973, the Career Development Review Branch (CDRB) was abolished. To administer the phaseout operation, the Office of Research Manpower was established in the Office of the Director, DRG, in May 1973. Coordinating officials in participating institutions were notified of the termination of the programs and furnished with additional administrative details on continuation of committed grants/awards.

The Division collaborated with other DHEW elements in developing official Department policy relating to the care and treatment of laboratory animals. The policy now extends to all warmblooded species. The policy on the protection of human subjects has been rewritten for issuance in the Federal Register and ultimate promulgation as part of the Code of Federal Regulations. The Division's Institutional Relations Branch coordinates the implementation of the policy by all DHEW agencies and informs DHEW grantees and contractors of decisions made by the Director, NIH, on behalf of the Office of the Secretary, HEW. A draft Federal policy is being developed at the request of the Assistant Secretary of Health.

Several workshops were initiated and organized by the Division's study sections during the year to study the state of the art in a variety of fields.

Conferees met in New Orleans, La., on Sept. 13, 1972, to explore the status of research on disease in man and animals caused by human or zoonotic species of filariae and the pathology associated with these parasites; in Los Alamos, N. Mex. on Oct. 2-3, 1972, to define the uses of accelerated particles in radiation therapy; on Jan. 11, 1973, in La Jolla, Calif., to explore experimental models for studying neural behavior; and on Jan. 11-12, 1973, in Bethesda, Md., on maturation of the fertilizing ability of mammalian spermatozoa, answers to many problems in the process of which may prove to be important in fertility control.

"Drugs and the Sea," was the subject of a workshop convened on Jan. 11-12, 1973, in La Jolla, to assess the state of the art and to assist study section members to evaluate the relative novelty, originality and scientific merit of the increasing number of research grant applications in this interdisciplinary area. The widespread occurrence of symbiosis, toxic chemical defense mechanisms and pheromone communication among marine organisms is being recognized. They have provided powerful stimuli to basic studies, as has the discovery of prostaglandins comprising 2 percent of the dry weight of the coral *Plexaura homomalla.* Other powerful stimuli have been the discovery of halogenated antibictics in marine organisms and the switch from the search for antitumor natural products from well-exploited land plants to the virtually untouched life in the sea.

At a nutrition workshop convened in Denver, Colo., on Jan. 22, 1973, participants discussed digestion, absorption, and malabsorption, including new aspects of small intestinal functions; adaptive response of jejunal enzymes to diet; the role of bile acid micelles in facilitating fatty acid and steroid absorption into the intestinal mucosa; absorption and transport of amino acids, and an approach to chronic intestinal disorders were among the topics covered. A workshop convened in New Orleans, La., on Jan. 25, 1973, discussed the current status of hypothalamic releasing and inhibiting factor in depth.

The Statistics & Analysis Branch continued its efforts to augment the base of information maintained in the IMPAC data system by expanded program coverage and the addition of new items to provide a full range of management information covering NIH extramural activities. New areas covered include information on research and project contracts, interagency and intraagency agreements, and special foreign currency (P.L. 480) programs. Action was initiated to include the categories of cost budgeted by the NIH program managers for annual grant awards and, in addition, a committee management file was established which includes information on all members of NIH advisory groups, boards, and committees.

Division of Research Resources

The Division of Research Resources, whose major purpose is to aid NIH categorical extramural research, concentrated its efforts in Fiscal 1973 in areas offering potential for substantial development of resources for biomedical research.

Million-Volt Electron Microscopy

The world's first million-volt electron microscopes to be used exclusively for biomedical research went into operation in Wisconsin and Colorado. Financed by the Biotechnology Resources Branch, these facilities are available to American scientists who want to delve further into various specialized cell studies.

One million-volt facility is located in the Animal Science Building at the University of Wisconsin, Madison; the other is housed in the Molecular Cellular and Developmental Biology Building at the University of Colorado, Boulder.

The microscopes allow scientists for the first time to routinely make three-dimensional cell photos. These provide detailed information on the three-dimensional form of complex cell structures not available by other means. The higher energy electrons of the new microscopes are also able to penetrate specimens up to 40 times thicker than those previously used.

The greater penetrating power of the instruments may one day permit scientists to place living tissue in a special environmental chamber at atmospheric pressure and high humidity. This procedure could be an important step toward understanding the biological events and processes of living systems.

Outpatient General Clinical Research Center

The General Clinical Research Centers Branch launched its first full-fledged discrete outpatient clinical center. Located at Vanderbilt University in Nashville, Tenn., the clinic offers an economical and rapid method of conducting ongoing studies with persons who are not hospitalized.

Outpatient clinical studies are essential for certain types of research in which hospitalization is not required: for example, in chronic disease, genetic, and mental health studies. Major research at the Vanderbilt Center includes investigation into hypertension, obesity, and pediatric diseases.

Individuals involved in these studies check into the Vanderbilt Center for a few hours instead of being hospitalized for days. Often they can receive treatment or tests in the morning before their workday begins.

A second outpatient clinical research center will open soon at the Johns Hopkins University School of Medicine in Baltimore, Md.

Minority Schools Biomedical Support Program

Fourteen new grants totalling $1 million were added to the Minority Schools Biomedical Support Program in FY 1973. Begun in FY 1972, the program is designed to strengthen biomedical research in health professional schools, 4-year colleges, and universities at which students are drawn mainly from ethnic minority groups.

The program now involves 45 Black institutions, one predominantly American Indian college, one Hawaiian, two Puerto Rican, seven predominantly Mexican-American schools, and one school with large Black, Oriental, and Mexican-American enrollments.

Primate Shortage

Recognizing an impending shortage of primates for laboratory use, the Animal Resources Branch initiated a survey of worldwide primate population—the first such primate population study to be undertaken.

A shortage of monkeys and apes for research, expected to occur within the next 5-10 years, could necessitate the breeding of all subhuman primates by investigators.

To help solve this problem, the survey will analyze available data, followed by field studies, and identify the primates that may have to be bred in the U.S.

Division of Research Services

The Division of Research Services provides NIH research investigators with support in biomedical engineering and instrumentation, environmental control, testing and protection services, library services, medical art and photography, animal production and care, and media production.

Dr. Joe R. Held, former chief of the Veterinary Resources Branch, was appointed Director, effective July 10, 1972, replacing Dr. Roger Estep.

Significant improvement was made in employee development through employment of an Equal Employment Opportunity Specialist, the Division's Human Relations Committee and expanded on-the-job and formal training. Visual communications projects expanded within the Division and other NIH Institutes and Divisions, particularly in areas of training and scientific communication by visual means.

Biomedical Engineering and Instrumentation Branch

The validity of pharmacokinetic models was increased and fundamental investigation of polymer kinetics and novel fabrication techniques enhanced the application of implant materials. The dependence of atherosclerotic plaque formation on blood flow dynamics was clarified. New transducers, improved video signal processing, and noninvasive scanning systems provided cardiovascular and neurological researchers with uniquely versatile tools. An automated testing apparatus increased the reliability and economy of procedures for safety checking hospital electrical equipment. Significant refinements in Nuclear Magnetic Resonance, mass spectrometry, fluorometry, and thermometry were achieved. Automation and mechanization of routine laboratory procedures advanced with innovations in electromechanical and fluidic techniques.

Environmental Services Branch

Biohazard control and pollution abatement received emphasis. A standing NIH Biohazard Committee was appointed. Biohazard procedure manuals were developed and assistance was provided in developing NIH/HEW environmental impact statements. Testing of bio-control systems continued along with occupational health surveys. Research needs for high purity water were identified. These efforts were aided by support contracts.

Library Branch

Mrs. Ruth Smith, former director of the Scientific Documentation Division in the Naval Ship Systems Command, U.S. Navy, joined DRS in April 1973, as chief of the Library Branch.

The NIH Library continued to provide on-line bibliographic searching through National Library of Medicine's MEDLINE computer system.

New photo-copying equipment improved services to NIH Institutes. Written translations were shifted almost exclusively to contractors.

Medical Arts and Photography Branch

The Medical Arts and Photography Branch kept abreast of its program commitments by the use of new and improved technology and a 100 percent increase in outside contract services. Microphotography skills and service output increased. The photographic laboratory was extensively renovated and reorganized to improve production.

Veterinary Resources Branch

The Veterinary Resources Branch provides NIH investigators with living models, life support systems for biomedical research and facilities and services related to these models and systems.

Contracting for 126,000 non-inbred rodents reduced in-house production from the previous year and allowed for increased VRB production of inbred strains used at NIH, but not commercially available. The procurement of nonhuman primates continued at a level similar to recent years, while random source dog procurement continued to increase.

Over 110 investigators world-wide were supplied with nucleus inbred breeders for VRB rodent genetic repository pedigreed colonies. The Frederick Cancer Research Center also was provided with inbred strains to assure the reliability of nucleus stock.

Surgical activities and support continued to increase from 700 procedures last year to over 900 this year. Surgical facilities are now used at near maximum capacity.

The number of calls for the Animal Disease Investigation Service increased 17 percent over the last year, from 128 to 150, including several in-depth surveys of animal care programs requested by NIH Institutes.

Dr. Robert Whitney, Jr., formerly with the Division of Research Resources, was named chief, Veterinary Resources Branch, in November 1972.

Dr. Stephen Potkay was appointed chief of the NIH Animal Center in May 1973.

Fogarty International Center

The programs of the Fogarty International Center for Advanced Study in the Health Sciences promote the concept of advanced study in the biomedical and related sciences. They also help develop practical methods to utilize the knowledge thus gained to improve the health and well-being of the people of the United States. The Center's programs encouraged study, cooperation, and collaboration within the international biomedical community and provide opportunities for the study and discussion of significant research, public health issues, and social and economic issues related to medicine.

Advanced Study

In Fiscal Year 1973, utilizing the services of outstanding university and Federal specialists, the Center initiated a series of studies in preventive medicine. Fifteen areas were selected for study, among them diseases of fetal development, trauma, emergencies and emergency care, communicable diseases, gastrointestinal diseases, nutritional disorders, problems of population control, and diseases of bones and joints. These disease-oriented studies are designed to review the state of the art of the prevention and control of human diseases, identify areas requiring further research, and identify defects in the translation of existing knowledge to public health benefit. Monographs in each study area will be published, and resource material will be developed for use in the departments of preventive medicine in medical schools.

Through its conference program, the Center organizes and sponsors working conferences on current and future directions in the biological and behavioral sciences. Twelve conferences were held during Fiscal 1973 on specific problems relating to the following general areas: health problems in developing countries; medical education; social aspects of advances in biomedicine; and advanced topics in biomedical research, as well as preventive medicine. Conferences held in previous years resulted in approximately 10 published conference proceedings and reports in Fiscal 1973.

Geographic Health Studies

Since its inception five years ago, the Center has supported and promoted studies in the science, medicine, and public health of other countries. Because the U.S. had little knowledge of developments in the Union of Socialist Soviet Republics, emphasis in the geographic studies program was originally placed on developing knowledge concerning medicine and public health there. Over two years ago the Center expanded its interests in overseas medical developments to include the People's Republic of China. These efforts resulted in the publication of five reports in Fiscal 1973. It is expected that accelerated effort in this program will result in the publication of approximately 10 studies on medicine and medical research in the USSR and the People's Republic of China next year.

Scholars and Fellowships

The Fogarty Scholars-in-Residence Program, designed to facilitate the work of individual scholars and the exchange of ideas among scholars, distinguished science leaders, and promising young scientists, welcomed 11 new scholars from six countries to NIH in Fiscal 1973. Activities of the scholars while at NIH vary widely. Some devote their time to individual study and writing. Others place an emphasis on collaborating with other scholars, and participating in workshops and seminars.

The NIH's International Research Fellowship Program, which promotes collaborative relationships between American biomedical sciences and promising young foreign scientists, also is administered by the Center. Last year 86 fellowships were awarded, and recipients were at work in research institutions throughout the country. Under NIH's Visiting Fellows Program, 168 Visiting Fellows from abroad were at work at NIH in Fiscal 1973.

Support Functions

The Fogarty International Center also provides administrative support to vital international activities.

For example, research abroad is supported by NIH through the Special Foreign Currency Program (Public Law 480), administered by the Center. Paid for with U.S.-owned foreign currencies, all projects are of a collaborative nature. In Fiscal 1973, research in Israel and Yugoslavia, previously supported by P.L. 480 funds, began to be supported by newly established foundations supported by both governments involved in each country.

The Center's International Education Branch arranges for the training of medical and allied health personnel from foreign countries who are studying in the U.S. under auspices of the World Health Organization and the Pan American Health Organization. Last year, the branch processed over 500 applications for training.

Hundreds of foreign scientists, from doctoral candidates to Nobel Prize winners, are attracted to NIH. Last year, the Center's International Visitors Center, which serves as a focal point for the reception of scientists and dignitaries from abroad, welcomed and assisted over 350 scientists from 52 countries.

NATIONAL INSTITUTES OF HEALTH EMPLOYMENT BY COMPONENT, JUNE 30, 1973

Component	1972 Permanent Full-time	Comparison	1973 Permanent Full-time
Total	11,166	+101	11,267
Office of the Director	[1] 1,843	+31	1,874
NIAID	623	−13	610
NIAMDD	585	−1	584
NCI	1,665	+71	1,736
NICHD	482	+34	516
NIDR	288	+2	290
NIEHS	235	−5	230
NEI	117	+5	122
NIGMS	167	−17	150
NHLI	618	+29	647
NINDS	557	−23	534
CC	1,395	+39	1,434
FIC	59	−6	53
DCRT	270	−4	266
DRG	407	−9	398
DRR	78	−3	75
DRS	529	0	529
BHME	783	−24	759
NLM	465	−5	460

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[1] Includes NIH Central Services and Program Direction functions.

NATIONAL INSTITUTES OF HEALTH APPROPRIATIONS FISCAL YEAR 1973*

(In thousands of dollars)

	TOTAL	NCI	NHLI	NIDR	NIAMDD	NINDS	NIAID	NIGMS	NICHD
Total	$2,535,062	$493,346	$300,503	$47,123	$167,728	$130,963	$113,755	$183,198	$130,744
Grants	1,124,008	216,642	177,709	31,599	134,522	99,640	78,557	171,883	89,114
Research	925,457	195,142	150,695	24,637	113,651	80,526	65,996	108,763	73,730
Fellowships	49,756	4,750	7,671	1,692	5,799	2,790	3,579	15,609	3,786
Training	148,795	16,750	19,343	5,270	15,072	16,324	8,982	47,511	11,598
Direct Operations	536,637	220,504	122,794	15,524	33,206	31,323	35,198	11,315	41,630
Direct research	125,578	24,420	19,783	7,057	19,957	11,261	19,222	-------	12,450
Research contracts	304,438	148,871	91,574	5,381	6,224	8,285	10,928	4,911	22,358
Collaborative studies	47,200	34,697	-------	361	1,233	7,988	2,245	-------	676
Biometry & epidemiology	5,220	-------	1,778	1,015	1,309	-------	-------	-------	651
Research management	51,892	12,516	9,659	1,710	4,483	3,789	2,803	6,404	5,495
International center	2,309	-------	-------	-------	-------	-------	-------	-------	-------
Construction	56,200	56,200	-------	-------	-------	-------	-------	-------	-------
Health Manpower Education[2]	743,076	-------	-------	-------	-------	-------	-------	-------	-------
Health manpower	739,076	-------	-------	-------	-------	-------	-------	-------	-------
Health professions	482,581	-------	-------	-------	-------	-------	-------	-------	-------
Dental health	14,979	-------	-------	-------	-------	-------	-------	-------	-------
Nursing	168,434	-------	-------	-------	-------	-------	-------	-------	-------
Public health	22,631	-------	-------	-------	-------	-------	-------	-------	-------
Allied health	38,705	-------	-------	-------	-------	-------	-------	-------	-------
Program direction	11,746	-------	-------	-------	-------	-------	-------	-------	-------
Loan funds	4,000	-------	-------	-------	-------	-------	-------	-------	-------
National Library of Medicine	28,724	-------	-------	-------	-------	-------	-------	-------	-------
Office of the Director	12,298	-------	-------	-------	-------	-------	-------	-------	-------
Buildings & Facilities	8,500	-------	-------	-------	-------	-------	-------	-------	-------
Scientific Activities Overseas[3]	25,619	-------	-------	-------	-------	-------	-------	-------	-------

NATIONAL INSTITUTES OF HEALTH APPROPRIATIONS FISCAL YEAR 1973*

(In thousands of dollars)

	NEI	NIEHS	RR[1]	FIC	BHME[2]	NLM	OD	B&F	SAO[3]
Total	$38,607	$31,067	$75,114	$4,697	$743,076	$28,724	$12,298	$8,500	$25,619
Grants	30,802	19,728	71,424	2,388					
Research	25,602	15,333	70,882	500					
Fellowships	1,802	264	126	1,888					
Training	3,398	4,131	416						
Direct Operations	7,805	11,339	3,690	2,309					
Direct research	3,583	7,845							
Research contracts	2,122	2,354	1,430						
Collaborative studies									
Biometry & epidemiology	467								
Research management	1,633	1,140	2,260						
International Center				2,309					
Construction									
Health Manpower Education[2]					743,076				
Health manpower					739,076				
Health professions					482,581				
Dental health					14,979				
Nursing					168,434				
Public health					22,631				
Allied health					38,705				
Program direction					11,746				
Loan funds					4,000				
National Library of Medicine						28,724			
Office of the Director							12,298		
Buildings & Facilities								8,500	
Scientific Activities Overseas[3]									25,619

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* Figures represent the amounts contained in the continuing resolution remaining in effect in FY 1973. Final action on appropriations was never completed.

[1] Formerly General Research and Services (GR&S); now Research Resources.

[2] Formerly Bureau of Health Professions Education and Manpower Training; now Bureau of Health Manpower Education.

[3] Special foreign currency program (PL 480) included in NIH budget for administrative purposes.

NIH GRANTS AND AWARDS BY NIH COMPONENT AND PROGRAM, FISCAL YEAR 1973[1]

(Amounts in millions of dollars)

	Total	Research grants[2]		R&D contracts[3]		Research training grants		Research fellowships, traineeships[4]		Research career program awards		Education grants[5]		Construction grants		Medical library grants	
NIH Component	Amt.	No.	Amt.	No.	Amt.	No.	Amt.	No.	Amt.	No.	Amt.	No.	Amt.	No.	Amt.	No.	Amt.
Total	$1,749.7	11,317	$815.2	1850	$276.4	1,719	$104.6	1378	$13.0	1089	$25.9	4,306	$418.5	38	93.4	166	$ 2.7
I/RD	1,230.1	11,223	811.6	1525	243.9	1,696	103.1	1233	12.2	1087	25.9	—	—	20	33.5	—	—
NIAID	76.6	1,102	59.3	102	8.5	126	6.4	41	0.4	81	2.0	—	—	—	—	—	—
NIAMDD	115.1	1,767	91.7	87	6.8	249	11.7	123	1.2	152	3.7	—	—	—	—	—	—
NCI	339.3	1,804	157.2	638	132.8	196	13.0	91	1.0	77	1.8	—	—	20	33.5	—	—
NICHD	88.9	945	61.0	197	17.9	97	6.9	44	0.5	109	2.6	—	—	—	—	—	—
NIDR	29.7	284	21.2	47	4.4	73	3.0	38	0.5	22	0.5	—	—	—	—	—	—
NIEHS	15.9	148	12.6	14	1.1	27	2.0	3	[6]	9	0.2	—	—	—	—	—	—
NEI	28.1	458	22.4	20	2.1	44	2.4	57	0.7	19	0.5	—	—	—	—	—	—
NIGMS	140.6	1,284	92.6	11	2.9	447	32.7	520	4.2	371	8.3	—	—	—	—	—	—
NHLI	212.1	1,550	136.7	314	55.4	219	14.3	71	0.8	181	4.9	—	—	—	—	—	—
NINDS	84.7	1,170	62.7	60	8.3	209	10.6	143	1.8	66	1.4	—	—	—	—	—	—
DRR	97.1	711	94.1	20	2.7	9	0.3	4	[6]	—	—	—	—	—	—	—	—
FIC	1.0	—	—	—	—	—	—	98	1.0	—	—	—	—	—	—	—	—
DRS, DCRT	0.1	—	—	7	0.1	—	—	—	—	—	—	—	—	—	—	—	—
CL, OD, Joint	0.8	—	—	8	0.8	—	—	—	—	—	—	—	—	—	—	—	—
BHME	508.5	47	2.6	252	25.9	14	0.9	138	0.7	2	[6]	4306	418.5	18	59.9	—	—
OD	13.6	1	[6]	59	8.3	—	—	—	—	—	—	48	5.3	—	—	—	—
DAHM	35.3	—	—	70	4.6	—	—	—	—	—	—	889	30.6	—	—	—	—
DDH	7.5	3	0.2	34	2.0	5	0.2	2	[6]	2	[6]	31	5.0	—	—	—	—
DMI	2.2	—		39	2.2	—	—	—	—	—	—	—	—	—	—	—	—
DN	122.2	43	2.4	30	2.7	9	0.7	136	0.6	—	—	2,458	106.3	8	9.5	—	—
DPHPE	327.8	—	—	20	6.1	—	—	—	—	—	—	880	271.3	10	50.4	—	—
NLM	11.1	47	1.0	73	6.6	9	0.7	7	0.1	—	—	—	—	—	—	166	2.7

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[1] Excludes scientific evaluation grants.

[2] Includes General Research Support programs.

[3] Includes contracts awarded by the National Library for tecnical development, and also training and development contracts awarded by the Bureau of Health Manpower Education.

[4] Includes NINDS traineeships.

[5] Includes institutional grants (formula), special project grants, and awards for student assistance.

[6] Less than $50 thousand.

Note: Dollars may not add due to rounding. Supplemental grants are combined with parent grants or with other supplements when both awards are financed from the same fiscal year funds.

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